Cornell University Announcements

New York State College of Agriculture and Life Sciences

1972-73

A Statutory College of the State University,
Cornell University, Ithaca, New York

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Cornell Academic Calendar
1972–73

Registration, new students	Thursday, August 31
Registration, continuing and rejoining students	Friday, September 1
Fall term instruction begins, 7:30 a.m.	Monday, September 4
Thanksgiving recess:	
Instruction suspended, 1:10 p.m.	Wednesday, November 22
Instruction resumed, 7:30 a.m.	Monday, November 27
Fall term instruction ends, 1:10 p.m.	Saturday, December 9
Independent study period begins, 2:00 p.m.	Saturday, December 9
Final examinations begin	Thursday, December 14
Final examinations end	Friday, December 22
Registration, new and rejoining students	Thursday, January 18
Registration, continuing students	Friday, January 19
Spring term instruction begins, 7:30 a.m.	Monday, January 22
Spring recess:	
Instruction suspended, 1:10 p.m.	Saturday, March 17
Instruction resumed, 7:30 a.m.	Monday, March 26
Spring term instruction ends, 1:10 p.m.	Saturday, May 5
Independent study period begins, 2:00 p.m.	Saturday, May 5
Final examinations begin	Monday, May 14
Final examinations end	Tuesday, May 22
Commencement Day	Friday, May 25

The dates shown in the Academic Calendar are subject to change at any time by official action of Cornell University.

Contents

The courses and curricula described in this *Announcement,* and the teaching personnel listed herein, are subject to change at any time by official action of Cornell University.

Cornell University

New York State College of Agriculture and Life Sciences

History

Cornell University, the land-grant institution for New York State, was chartered by the legislature of the state of New York in 1865. By the terms of the Morrill Land Grant Act of 1862, teaching in agriculture has been, from the beginning, a regular part of the University program. In 1904 the legislature established the "New York State College of Agriculture at Cornell University," as a state institution and made an appropriation for the erection of buildings for the College. In 1906 an administration act was passed by the legislature defining the purpose and activities of the College thus: "The object of said College of Agriculture shall be to improve the agricultural methods of the state; to develop the agricultural resources of the state in the production of crops of all kinds, in the rearing and breeding of livestock, in the manufacture of dairy and other products, in determining better methods of handling and marketing such products, and in other ways; and to increase intelligence and elevate the standards of living in the rural districts. For the attainment of these objects the College is authorized to give instruction in the sciences, arts, and practices relating thereto, in such courses and in such manner as shall best serve the interests of the state; to conduct extension work in disseminating agricultural knowledge throughout the state by means of experiments and demonstrations on farms and gardens, investigations of the economic and social status of agriculture, lectures, publication of bulletins and reports, and in such other ways as may be deemed advisable in the furtherance of the aforesaid objects; to make researchers in the physical, chemical, biological, and other problems of agriculture, the application of such investigations to the agriculture of New York, and the publication of the results thereof."

In 1948, the State University of New York (S.U.N.Y.) was "created to provide a comprehensive and adequate program of higher education," and the College of Agriculture, as one of the four statutory colleges at Cornell University, became an integral part of it. S.U.N.Y. now includes more than fifty educational institutions. Functioning in this broad context, the College, renamed the College of Agriculture and Life Sciences in 1971 to reflect the widened scope of its activities and concerns, offers teaching and research facilities to serve the people of New York State.

Curricula

The Bachelor of Science degree program in the College of Agriculture and Life Sciences is a four-year course of resident instruction in agriculture and in the sciences most closely related to agriculture. The program is designed to provide the graduate with a broad, basic education that will enable him to deal successfully with the changes and responsibilities that he will encounter later on in life.

In addition to the regular four-year program, the College offers organized curricula for students with special interests including degree programs which combine work in the College and in other academic units of the University (see p. 13); special one-year courses; a five-year cooperative education program (p. 12); a summer school program designed for teachers, principals, and superintendents; and one- and two-week courses with specific purposes.

Subjects of Study

The requirements for a degree, as outlined on p. 9, are extremely flexible. Only a few specific courses are required, and each student, with the help of his faculty adviser, designs a program to fit his own particular needs and interests. He may choose a broad, basic course or one in which specific basic or applied sciences are emphasized. The following list of subjects indicates the wide range of possibilities available.

Agricultural Economics
- Agricultural Business Management and Marketing
- Agricultural Economics
- Farm Finance and Farm Management
- Food Distribution
- Resource Economics

Agricultural Engineering
- Agricultural Technology
- Agricultural Engineering Technology
- Agricultural Engineering*

Agricultural Sciences

Agronomy
- Crop Science
- Field Crops
- Soil Science
- Soils (Including Soil Conservation)

Animal Science
- Animal Genetics (Breeding)
- Animal Nutrition
- Animal Physiology
- Dairy Production
- Lifestock Production
- Meat Science

Biological Sciences—Fields of Concentration:
- Animal Physiology and Anatomy
- Biochemistry
- Botany
- Ecology and Evolution
- Genetics and Development
- Microbiology
- Neurobiology and Behavior

Communication Arts

Cooperative Extension

Education
- Conservation Education
- Teaching Agriculture in High School
- Teaching Science in High School

Entomology

Floriculture and Ornamental Horticulture
- Floriculture
- Greenhouse Crop Production
- Landscape Architecture
- Landscape Horticulture
- Nursery Crop Production
- Turfgrass Management

Food Science

International Agriculture
- (Students must also complete the requirements for another specialization.)

Natural Resources
- Conservation
- Fishery Science
- Forest Science
- Outdoor Recreation
- Wildlife Science

Plant Breeding

Plant Pathology

Pomology
- Fruit Production
- Pomology

Poultry Science
- Poultry Production
- Poultry Science

Rural Sociology

Statistics and Biometry

Vegetable Crops
- Production and Marketing

* See the section on combination programs.

Admissions

It is the policy of Cornell University actively to support the American ideal of equality of opportunity for all, and no student shall be denied admission or be otherwise discriminated against because of race, color, creed, religion, or national origin.

Applicants for admission to the Bachelor of Science degree program in the College of Agriculture and Life Sciences must (1) be at least sixteen years of age, (2) have completed a secondary-school curriculum with a minimum of sixteen units (see below), and (3) present scores of the Scholastic Aptitude Test of the College Entrance Examination Board. New York State residents should submit scores from Regents examinations, and all applicants are urged to take College Board Achievement Tests in two of the following: English composition, mathematics, science. However, admission to the College involves more than meeting these specific requirements.

Admission is a competitive process and the College Admissions Committee should be supplied with information to aid in evaluation. A candidate's high school record, background, work experience, school and community activities, and his reasons for selecting his specific educational goal, are important elements in the evaluation. When all other factors are judged equal in an evaluation of two or more applicants, admission preference will be given to those who are residents of the state of New York.

A One-Year Special Curriculum is available to selected individuals who may not have had adequate academic preparation in high school for the degree course but who have demonstrated they have the academic potential, background, and interests for eventual success. The one-year curriculum is not designed to be terminal. Major emphasis is placed on preparing these students for transfer to the degree program. A candidate for this program must present the same credentials as a candidate for the degree program and must also have had approximately one year of work experience related to the stated vocational objective.

Requests for applications for admission to the freshman class, to a specific course, or to advanced standing from colleges and universities should be addressed to the Director of Admissions, Cornell University, Day Hall, Ithaca, New York 14850.

Completed applications should be returned to that office during the fall term of the applicant's senior year in high school. Applications for admission as freshmen will be received until January 15; until March 15 for transfer candidates.

Freshmen are admitted only in the fall term; students who enter by transfer with advanced standing may be admitted either term.

Secondary-School Preparation

Applicants must offer at least sixteen entrance units;* these must include four units of English, three units of mathematics, and three units of science. Units beyond the ten specifically required may be selected from any high school subjects acceptable by the University. These subjects include, among others, agriculture, bookkeeping, drawing, foreign languages, home economics, industrial arts, and social sciences.

It is strongly recommended that high school students carry enough courses to offer eighteen entrance units and that these include biology, chemistry, physics, and at least three and a half units in mathematics. Students who wish to major in one of the sciences in college or to become research workers should offer adequate training in foreign languages. If a candidate offers a foreign language for entrance, it is desirable to present at least two years of study in one language. Credit will be granted for a single year of study in not more than two languages.

Advanced Placement

Prospective entering freshmen who have taken college-level courses in secondary school may qualify for advanced placement (and often for advanced credit) in the following areas of study: biological sciences, chemistry, English, history, Latin, literature, mathematics, modern foreign languages, music, and physics.

In general those who wish to be considered for advanced placement or credit should take the appropriate advanced placement examination(s) of the College Entrance Examination Board in May. Some of the departments also offer their own examinations at entrance, as an alternative or supplementary method of

* A unit represents five recitations a week for one year in a subject. In drawing and industrial arts, 240 hours are required to earn one unit and 120 hours to earn a half unit.

determining advanced placement or credit.

Advanced Standing

A student admitted to the College of Agriculture and Life Sciences from another college in Cornell University, or from any other institution of collegiate rank, is regarded as having completed the number of terms and hours to which his records entitle him, and receives all the privileges of students who have completed the same number of terms and hours by residence in the College. He must furnish a transcript from the institution from which he transfers. No more than fifteen semester hours of credit are allowed for one semester of work at another institution. To obtain the degree of Bachelor of Science, however, a student must have completed the prescribed subjects and the requisite number of hours. He must also have been in residence in the College of Agriculture and Life Sciences for his past two terms and have completed no less than fifteen hours a term, of which at least two-thirds must be in subjects taught by the staff of the College of Agriculture and Life Sciences.

Credit toward a degree for secondary school work, beyond that used in satisfying entrance requirements, may be obtained through a satisfactory grade received in an Advanced Placement Test of the College Entrance Examination Board, in each subject.

Special Students

Special student status is extended to a limited number of students who wish instruction in selected agricultural courses in preparation for employment. This includes those who already have a first degree but want further undergraduate work. However, special student status should not be viewed as a way to improve a previous collegiate record in order to enter graduate or professional schools.

Applicants for admission as special students who are under twenty-one years of age must present entrance credentials as other students do, and, in addition, each must present a detailed statement of the program he wants to follow. Applicants more than twenty-one years old will be considered even without normal entrance credentials, but all applicants for special status must show that they have had recent farm experience or other experience qualifying them for the special work they plan to do.

Transfer to the degree course is sometimes possible for special students whose records are considerably better than average and who give evidence of their ability to carry advance work.

Health Requirements

Each entering student, graduate or undergraduate, is expected to assume personal responsibility for meeting the health requirements adopted by the Board of Trustees of Cornell University. Prospective undergraduate students should consult the *Announcement of General Information.* Graduate students should consult the *Announcement of the Graduate School.* Permission to register for a new semester will not be granted unless all health requirements pertaining to the previous semester have been fulfilled.

Further Information

For answers to specific questions regarding the College of Agriculture and Life Sciences' programs and admissions policies, and to make interview arrangements, write to the appropriate person in the Admissions Office, New York State College of Agriculture and Life Sciences, 195 Roberts Hall, Ithaca, New York 14850, or telephone the Admissions Office at 607/256-2057 or 607/256-2036. Professor Leonard W. Feddema, director of admissions, is in charge of overall policy and admission of freshmen. Gordon L. Peck, associate director of admissions, is responsible for transfer admission and recruitment; he is assisted by Richard A. Church, assistant director of admissions.

Applicants are not required to come to the College for interview purposes. Those who wish interviews should request appointments three to four weeks in advance. Interview hours are 10:00 a.m. to 12 noon and 2:00 p.m. until 4:00 p.m. daily, Monday through Friday. From January 15 to April 15, the admissions staff is engaged in selecting candidates for the entering class and thus unavailable for interview purposes.

Degree Requirements

Residence

Candidates for the degree of Bachelor of Science normally must be in residence for eight terms. Questions concerning exceptions to this requirement should be directed to the Office of Resident Instruction.

Credit

For the Bachelor of Science degree, a candidate must have 120 hours of credit in required and elective courses and a cumulative grade average of at least C (1.7) with an average of C or above in the last term. The last term is that semester or summer session at the end of which the student is eligible to be recommended by the faculty for a degree.

Distribution Requirements

Following is an outline of the course requirements for graduation. The required courses that are given in the College of Arts and Sciences are described in the *Announcement* of that College.

Requirement	*Credit hours*
Physical sciences, biological sciences, and social sciences and humanities	45
Group A: Physical sciences. A minimum of twelve hours in at least two subject areas, including six hours of chemistry or physics. Subject areas: astronomy (courses 201, 202); chemistry; geology; mathematics; meteorology (courses 201, 202); physics.	
Group B: Biological sciences. A minimum of twelve hours to include six hours of introductory botany, biology, and/or zoology with the remaining hours in at least two other subject areas. All undergraduate courses offered by the Division of Biological Sciences may be credited. Subject areas: animal physiology and anatomy (including Veterinary Medicine 310); biochemistry; botany; ecology, evolution, and systematics; entomology (courses 210, 212, 351); genetics and development (including Animal Science 220); microbiology (including Veterinary Medicine 390); neurobiology and behavior; organic chemistry; plant pathology (courses 301, 309, and 401); physical biology (including Veterinary Medicine 920.)	
Group C: Social sciences and humanities. A minimum of fifteen hours in at least two subject areas, including six hours of freshman humanities. Subject areas: American studies; Africana studies (courses 190, 203–204, 219, 231, 361, 475, 285, 321–322, 131, 171, 301, 290); economics; freshman humanities; government; history; history of architecture (course 401); history of art; international studies (courses 110, 209); comparative literature; modern foreign language; philosophy; psychology or Education 110; Human Development and Family Studies 115; Rural Sociology 100 or anthropology or sociology; Industrial and Labor Relations (courses 408, 409).	
Electives in the statutory colleges of which at least 45 hours must be taken in the College of Agriculture and Life Sciences	55
Electives (in any college in the University)	20
Total	120

College Proficiency Examination Program

Anyone wishing to obtain college credit through the College Proficiency Examination Program of the State Education Department should, prior to the taking of examinations, consult the director of resident instruction, Roberts Hall, as to conditions under which credit may be granted. Each application for credit assignment is considered on its own merits of purpose and preparation. The field in which credit is sought must be appropriate to the graduation requirements of the College, and the intent of the applicant must be clearly to use such credit toward meeting these requirements.

Physical Education

All undergraduates must complete four terms of work in physical education. Ordinarily, this requirement must be

completed in the first two years of residence; postponement is to be allowed only by consent of the University Faculty Committee on Requirements for Graduation. Exemption from this requirement may be made by the Committee when it is recommended by the University Health Services, or because of unusual conditions of age, residence, or outside responsibility. Students who have been discharged from the armed services may be exempted.

For students entering with advanced standing, the number of terms of physical education required is to be reduced by the number of terms which the student has satisfactorily completed (whether or not physical education was included in his program) in the college of recognized standing.

The Department of Physical Education provides information about its courses to entering students.

English Proficiency Examination

Each student must pass the written English Proficiency Examination, administered by a faculty committee, in order to qualify for the degree. The examination is given twice during each academic year, usually in December and May.

Work Experience

There are seven specializations in which students are required to obtain appropriate work experience before the senior year.

In the following specializations, students may satisfy the work experience requirement by earning ten units of practice credit through farm work experience and/or nonfarm work experience of a professional nature. The students' advisers designate the type of work experience.

Agricultural Education
Agronomy
General Agriculture
Pomology
Vegetable Crops

In the following specializations students satisfy the work experience requirement through ten units of appropriate experience of a professional nature in their fields of specialization.

Floriculture
Plant Breeding and Biometry

The following specializations do not require work experience but recommend that their students obtain work experience appropriate for their fields of specialization.

Agricultural Economics
Agricultural Engineering
Agricultural Sciences
Animal Science
Biological Sciences
Communication Arts
Cooperative Extension
Entomology
Food Science
Natural Resources
Plant Pathology
Poultry Science
Rural Sociology
Science Education

The Student Practice Office is responsible for evaluating *all* farm experience and at the time of matriculation evaluates the farm experience of all students regardless of their specialization. This is done because a number of students change their specialization after matriculation. Every student is obliged to satisfy the experience requirement of the specialization for which he or she is enrolled at the beginning of the senior year.

Students who wish to have work experience evaluated for credit should: (1) report their position either before they start work or at the time their job begins, and (2) prepare a report on their work experience and submit it to the Student Practice Office or specialization adviser. Forms for this purpose are available at the Student Practice Office.

Considerations involved in establishing the farm experience credits at entrance are (1) desirability of the farm from the standpoint of obtaining good experience; (2) the student's report on his farm experience; (3) reports from the farmer on the student's work; and (4) the length of time of the work experience.

A representative of the Student Practice Office or specialization representative will visit most students whose employment location is in New York State or neighboring areas. The work experience will be evaluated and reported to the student. Pertinent information on the work

experience will be kept in the student's folder and reported to the Office of Resident Instruction so it may be entered on the student's college record.

In some specializations, the type of experience required varies with the qualifications or interest of the individual student. In certain instances, experience of a specific type is expected early in the college career, while in others it is preferred that the experience be delayed until the junior year. Because of these variations, it is desirable for students to discuss the question of specialization and the experience required, if any, with their advisers as soon as possible. The responsibility for doing this rests with the students. Students may find that it is helpful to talk with advisers in several fields, with other counselors, and with members of the Student Practice Office.

Members of the faculty and the Student Practice Office will make suggestions and be of whatever assistance they can to students who are seeking suitable work experience. The department concerned sometimes assists in finding employment for specialization experience. However, the College can assume no responsibility for assuring the student that appropriate employment will be found and no responsibility for acceptability to the student of particular working or living conditions.

Students who wish assistance in obtaining appropriate employment, whether required or not, should file a work assistance application with the Student Practice Office, 16 Roberts Hall. For some fields of work civil service examinations are required. For employment the following summer, these examinations need to be taken in December or January.

Academic Honors

Bachelor of Science with Distinction

The degree of Bachelor of Science with distinction will be conferred upon those students who, in addition to having completed all of the requirements for the Bachelor of Science degree, shall have done all of their undergraduate work at Cornell University and have cumulative averages of B+ (3.3 quality points) or above; and upon those transfer students who have been in residence for at least two years and have cumulative averages of A− (3.5 quality points) or above at Cornell.

Bachelor of Science with Honors

The Honors program in the College is guided by five broad area committees in the plant sciences, animal sciences, social sciences, physical sciences, and biology. Each participant carries out independent research under the direction of a faculty member when the student has received written acceptance into the Honors program. Requirements for entering the Honors program include completion of fifty-five semester credit hours, of which at least thirty hours have been at Cornell University, and a cumulative grade point average at the time of entrance into the Honors program of at least 3.0. Exceptions may be made for the thirty hours required at Cornell for transfer students with exceptional qualifications.

Each report on independent research will be reviewed by the Honors committee having appropriate jurisdiction. The chairman of each Honors committee will recommend, in writing, to the Office of Resident instruction those students who are expected to be graduated with Honors. These recommendations must be received before the date on which midterm grades are due in the semester at the end of which the student expects to graduate. Students so recommended will have diplomas ordered for them with the notation "With Honors."

Dean's List

Excellence in scholarship is recognized twice a year by publishing as a Dean's List the names of those students who have completed at least twelve hours of course work for letter grades, who are in good standing, and whose semester averages in academic courses are B+ (3.3 quality points) or above.

Registration for Courses

In making his program, the student has the assistance of a faculty adviser, preferably from the field in which he expects to specialize. The adviser is ordinarily assigned to the new student for the first term, but following that he is chosen by the student. Other counselors to assist

students on personal matters, vocational guidance, and placement are available in the Office of Resident Instruction, Roberts 192.

A student must register for at least twelve hours each term, and no new student may register for more than eighteen hours per term in addition to the regular work in physical education.

Freshman Year

The standard schedule for the freshman year must include the following courses:

Course	*Credit Hours*
Physical Education	0
Freshman Humanities	6
Biological Sciences 101–102 (or equivalent) or 107–108	6
Chemistry or Physics	6
Elective courses in the College of Agriculture	6
Elective courses in the basic sciences, in social sciences and humanities, or in the College of Agriculture	3–6

Electives

Below is a partial list of general courses offered by the various departments. Students will find this list helpful in selecting electives outside of their major field. All of the courses listed, except those followed by an asterisk, are open to freshmen.

Agricultural Economics 150, 240*
Agricultural Engineering 104, 106, 107, 152, 153, 204, 205, 222, 233, 234
Agronomy 111 (crop science), 200* (soil science)
Animal Science 100, 112, 220*, 250, 260, 265
Biological Sciences 101–102, 107–108
Biological Sciences 431* (biochemistry), 280*, 281* (genetics), 290* (microbiology)
Education 110
Entomology 212*, 260
Floriculture 101
Food Science 101
Landscape Architecture 102
Landscape Architecture 109–110, 111 (freehand drawing)
Meteorology 201
Orientation 1, 5, 7, 101, 110
Plant Pathology 301*
Pomology 101, 102
Poultry Science 100
Rural Sociology 100
Vegetable Crops 103, 210*, 222*

Courses Taken Outside the College

Senior students who have met all college requirements and desire to take courses outside the College of Agriculture and Life Sciences, in addition to those required or allowed free, may do so upon paying for the additional hours at the rate of tuition prevailing in the colleges in which the courses are taken. Other students are not allowed to exceed, even by paying for the excess hours, the twenty hours of endowed college courses charged to this category unless they have met, or at the same time are meeting, the minimum agricultural elective requirement. Senior students whose cumulative averages are 3.0 or above, and who are recommended by the department in which their major work is done, may be permitted to elect, without additional payment, up to ten hours outside the College of Agriculture and Life Sciences beyond the twenty hours normally allowed for election in any college.

Special students may not elect more than one-third of their hours in any semester outside of the College of Agriculture and Life Sciences. Tuition for work taken outside will be charged at the rate prevailing in the College where the work is done.

Courses in advanced ROTC may be taken, in addition to the twenty hours of free electives outside the College, without payment for those excess hours.

Failures in courses, either required or elective, taken outside the College of Agriculture and Life Sciences are counted against the allotment of the twenty free hours that may be taken in any college.

Cooperative Education Program

The five-year Cooperative Education Program, offered for the first time in 1971, provides an opportunity for students to alternate periods of organized training or

internship with periods of academic study. The combination is designed to allow students to explore career interests, to learn through experience the interrelationships of classroom instruction and job performance, and thus to be better prepared to develop course programs relevant to their career goals. The five-year period includes up to fourteen months of practical work experience.

To be admitted to the Program, a student must (1) file a written request early in the spring semester of the sophomore year, (2) have a minimum cumulative average at the end of the fall semester of the sophomore year of C+ (2.30), and (3) have a written job offer from a cooperating employer in a work assignment appropriate for the student's field of study.

The first work period occurs during the fall semester of the third year. This is followed by on-campus course enrollment in the spring semester of the third year and fall semester of the fourth year. The spring semester of the fourth year and ensuing summer constitute the second work period. The fifth year involves enrollment in courses on campus; the degree is awarded at the end of this year. While students are working off campus, they are registered in absentia and considered regular full-time students.

The training program must be approved by the program coordinator or his representative to ensure that the work experience is appropriate for the student's educational program and vocational objective. During work periods, the student will receive reasonable compensation from the employer. Training programs will be reviewed periodically and the employer will submit to the program coordinator a written report on the student's performance. A student may request in writing that his enrollment in the Program be terminated. On the other hand, if the student's performance is unsatisfactory, his enrollment may be terminated by written notice to him from the coordinator.

The student works for the same employer during both work periods, but there is no obligation either on the part of the cooperating employer to offer employment to the student following graduation or on the part of the student to accept employment.

For further information about the Cooperative Education Program, a letter may be addressed to Professor S. R. Shapley, Student Practice Office, Room 16, Roberts Hall, Cornell University, Ithaca, New York 14850.

Combined Courses

With the College of Engineering (Agricultural Engineering)

A joint program of the Colleges of Agriculture and Life Sciences and Engineering at Cornell University leads to the degree of Bachelor of Science at the end of four years. Students in this program register in the College of Agriculture and Life Sciences during the first three years but take courses in the Colleges of Engineering, Arts and Sciences, and Agriculture and Life Sciences. In the fourth year the registration is in the College of Engineering, which grants the degree.

Applicants for admission must meet the academic entrance requirements for the College of Engineering. These are sixteen units including: English, four units; one foreign language, two units; history, two units; elementary and intermediate algebra, two units; plane geometry, one unit; trigonometry, one-half unit; either advanced algebra, one-half unit, or solid geometry, one-half unit; chemistry, one unit, or physics, one unit (preferably both). It is recommended that the candidate offer advanced algebra, if possible, and that at least three of the elective units offered be in further study in language or history. The mathematics courses listed above may be taken as separate courses or may be included within four units of comprehensive college preparatory mathematics.

Each candidate for admission is required to take the Scholastic Aptitude Test of the College Entrance Examination Board and to request the Board to report the results to the Director of Admissions, Cornell University. Candidates are urged to take the tests in January of their senior year.

Each applicant must also take the College Entrance Examination Board achievement tests in advanced mathematics and either physics or chemistry. These tests should be taken not later than March of the year of the applicant's entrance to college.

Since it is the purpose of this curriculum to prepare engineers for a variety of agricultural specializations such as buildings, soil and water management, machinery, manufacturing and processing of agricultural products and supplies, drainage, irrigation, etc., evidence of interest in and background for engineering work in agriculture is a qualification for admission that is given careful consideration.

The curriculum includes basic work in biology, mathematics, physics, and chemistry; a well-rounded selection of courses in engineering science and technology, including agricultural engineering; courses in soils, crops, farm management, and other subjects in agriculture; and general studies to provide a broad and useful training.

Charges for tuition and fees, during the first three years in the curriculum, are the same as outlined on pg. 15, except that students in this combined course are required to take more courses outside the College of Agriculture and Life Sciences than are permitted to other students, for which they must pay, on a credit-hour basis, as soon as the regular allowance has been used up. The amount of the charge depends upon the specific courses that are taken but is approximately a total of $1,650 for the first three years. Payment for the excess hours begins in the second year, but the major part is paid in the third year. In the fourth year these students are subject to the tuition and General Fee charged in the College of Engineering, which at present totals approximately $1,500 each term.

In applying for admission the applicant should indicate in the application, which should be sent to the Director of Admissions at Cornell University, that he wants to enter the College of Agriculture and Life Sciences for agricultural engineering.

With Business and Public Administration

Properly qualified students of the College of Agriculture may, during their third year, apply for admission to a joint program between the College of Agriculture and Life Sciences and the Graduate School of Business and Public Administration. Under this program, the student who is admitted may complete the requirements for the Bachelor of Science degree for the College of Agriculture and Life Sciences at the end of his fourth year and for the degree of Master of Business Administration or the degree of Master of Public Administration at the end of his fifth year. The student in this program must successfully complete a minimum of thirty hours of course work in the Graduate School of Business and Public Administration during the fifth year.

A careful selection of courses is necessary if the two degrees are to be earned in five years; therefore, a student who is interested should plan his program with the help of the designated faculty adviser, beginning with the sophomore year. If the decision to apply is not made until later, consultation with the adviser is necessary to determine whether the requirements for the two degrees can be met in five years or if a longer time is needed.

The opportunity to receive these two degrees in five years, when the normal time is six years, is made possible by the inclusion of certain courses from the Department of Agricultural Economics that may be acceptable in lieu of certain first-year requirements by the Graduate School of Business and Public Administration. Similarly, the faculty of the College of Agriculture and Life Sciences accepts up to twenty-nine hours of courses in the School of Business and Public Administration in the fourth year. These substitutions are allowed only to those who have been accepted for admission by the Graduate School of Business and Public Administration and who have their schedules approved by the College of Agriculture and Life Sciences faculty adviser for this program.

In the fifth year the student registers only in the Graduate School of Business and Public Administration. The program of that year includes the remaining core subjects required of all students in business and public administration, together with elective courses. The specific courses to be taken depend upon the career interests of the student and are determined in consultation with his adviser. At the beginning of this fifth year the student will select a concentration from such areas as: industrial accounting, professional accounting, finance, international business operations, managerial economics, marketing, personnel man-

agement, production and operations management, quantitative analysis for managerial decision making, transportation, organizational theory and behavior, and agricultural management. Options within the agricultural management area include: management of farm cooperatives, agricultural credit administration, agricultural industries, agricultural marketing, public policy and the administration of government agricultural programs, and management of natural resources.

During the first four years these students are subject to the tuition requirements of the College of Agriculture and Life Sciences and in the fifth year to those of the Graduate School of Business and Public Administration.

For further details about this joint program and its admissions requirements reference should be made to the *Announcement of the Graduate School of Business and Public Administration.*

The College of Agriculture and Life Sciences and the Graduate School of Business and Public Administration also cooperate in a special program in food industry management. This joint effort carries the sponsorship of the National Association of Food Chains. The majority of the students have been employed in the food distribution industry, but the program also attracts others. Qualified degree holders may enroll in the Graduate School as candidates for the Master of Science or Doctor of Philosophy degree, or in the Graduate School of Business and Public Administration as candidates for the Master of Business Administration degree (which requires two years of residence). Undergraduates register in the College of Agriculture and Life Sciences as candidates for the Bachelor of Science degree. Others who are not interested in a degree enroll as special students in the College of Agriculture and Life Sciences and are granted a certificate at the successful completion of one year of work.

With the Graduate School of Nutrition

An agreement between the College of Agriculture and Life Sciences and the Graduate School of Nutrition permits qualified students of agriculture to follow a curriculum that leads to the regular degree of the College of Agriculture and Life Sciences at the end of the fourth year, and the degree of Master of Nutritional Science at the end of the fifth year. To meet the requirements for the two degrees in five years, instead of the normal time of six years, the student in agriculture should start planning his program with his adviser for students of nutrition not later than the end of the freshman year. During the first four years of this program, students are subject to the tuition requirements of the College of Agriculture and Life Sciences and in the fifth year to those of the Graduate School of Nutrition.

With the Veterinary College

Students who do their preveterinary work in the College of Agriculture and Life Sciences and are accepted by the Veterinary College at Cornell University sometimes qualify for degrees from both colleges. This takes about seven years and is ordinarily done by spending the first three years in Agriculture followed by four in the Veterinary College, including a combined registration in the College of Agriculture and Life Sciences during the semester in which the requirements for the B.S. degree are completed. The candidate must petition for combined registration prior to the beginning of the semester in which he qualifies for the degree.

Payments to the University

Tuition

Tuition and General Fee total $600 per term for undergraduate and special students registered in the New York State College of Agriculture and Life Sciences whose legal residence is in the state of New York at the time of registration for any term.

Tuition and fees total $900 per term for students who are not residents.

Since physical presence in the State, especially for persons under age, by no means constitutes legal residence, applicants who are at all doubtful of their right to qualify as New York State residents should address inquiries to the director of resident instruction in the College of Agriculture and Life Sciences. Changes in residence status are handled by the director of resident instruction.

Students transferring from the College

of Agriculture and Life Sciences to other colleges in the University must first make payment for the difference in tuition for the credit transferred.

Students desiring to take, while registered in the College of Agriculture and Life Sciences, courses in other colleges in the University beyond those specifically required and also beyond the twenty hours allowed free may do so upon payment of tuition for the additional hours at the rate of tuition in the college in which the work is taken.

The University bursar mails the student a statement of charges before the beginning of each term. The charges are payable within twenty days.

Any student, graduate or undergraduate, who fails to pay his tuition, fees, and other indebtedness within the time prescribed by the University is thereby dropped from the University.

If a student terminates a University registration by leave of absence or withdrawal, tuition and the general fee will be charged beginning with registration day to the effective date of the certificate of leave or withdrawal as follows: first week, 10 percent; second week, 20 percent; third week, 30 percent; fourth week, 40 percent; fifth week, 60 percent; sixth week, 80 percent; seventh week, 100 percent. No charge will be made if the effective date is within the first six days, including registration day.

The amount, time, and manner of payment of tuition, fees, or other charges may be changed by the Board of Trustees at any time without notice.

Fees and Instructional Expenses

A deposit of $50 must be paid after the applicant has received notice of provisional acceptance. At the time of the first registration in the University, the deposit is used to cover matriculation charges, provides for certain graduation expenses, and establishes a fund for undergraduate and alumni class activities. The deposit is not refundable.

A deposit of $30 is required for a uniform, payable at registration in the first term, for students who enroll in the basic course in military science. Most of this deposit is returned as earned uniform allowance upon completion of the basic course.

Payment of a General Fee is required at the beginning of each term. The exact amount of the Fee for the academic year 1972–73 had not been determined when this *Announcement* was printed. Students should refer to the *Announcement of General Information, 1972–73* for this information. The General Fee contributes toward the services provided by the libraries, the Gannett Clinic and Sage Infirmary, and the University unions. It also pays part of the extra costs of laboratory courses and general administration, as well as programs of physical recreation and student activities.

Books, instruments, and instructional supplies cost approximately $100 a term.

Miscellaneous Rules and Assessments

Every student is held personally responsible for any injury done by him to any of the University's property.

Assessments, charged to the student's account and payable at the bursar's office, are levied upon the student in certain circumstances, under the following rules of the University: (1) A matriculated student desiring to register after the close of registration day must first pay a fee of $10. (2) A student desiring to take an examination or other test for the completion of a course in which the grade "incomplete" was reported must first pay a fee of $10 for each examination or other test.

For reasons satisfactory to the proper authority, any of the above-mentioned assessments may be waived in any individual case if the student's failure to comply with the regulation was due to ill health or to any other reason beyond his control.

Financial Aid

Scholarships

Scholarships awarded by the College of Agriculture and Life Sciences and available only to students in the College of Agriculture and Life Sciences are listed on the following pages. *Applications for these scholarships should be made on the Cornell University Financial Aid Form* and must be supplemented by the parents'

confidential financial statement. Entering students must apply before January 15. Students in residence are expected to pick up application forms at the Office of Scholarships and Financial Aid, 105 Day Hall, before spring vacation and to see that these are filed before April 1.

Financial aid in the form of University scholarships, jobs, and loans is also awarded from other funds on a competitive basis to students entering or enrolled in any undergraduate division of the University. Brochures describing this aid are available from the Office of Scholarships and Financial Aid.

Recipients of Scholar Incentive Awards, Regents College Scholarships, Regents Scholarships for Children of Deceased or Disabled Veterans, and Special State Scholarships for Children of Disabled or Deceased Soldiers, Sailors, or Marines, who enroll at the New York State College of Agriculture and Life Sciences may apply the amount of money they receive toward their college expenses.

George O. Adams Scholarship. An annual scholarship is provided by the Western New York Nurserymen's Association Foundation in memory of George O. Adams, a prominent member of the Association. Students in any class who are specializing in the Department of Floriculture and Ornamental Horticulture and who are recommended by that Department are eligible. The selection from among those eligible is based on character, scholastic record, and financial need.

The Robert M. Adams 4-H Memorial Scholarship was established in memory of Professor R. M. Adams by the 4-H Clubs of the state. The endowment yields approximately $50 a year. Students who are New York State residents are eligible to apply after their first year in the College; those who have been 4-H Club members are given first consideration. The award is based on financial need, character, ability, and scholarship.

College of Agriculture and Life Sciences Fund Scholarships. The income from an endowment fund established through the efforts of the Alumni Association of the New York State College of Agriculture and Life Sciences provides scholarships for students in the College. Preference will be given to students transferring from two-year colleges in New York State. Selection is based on character, academic achievement, and financial need.

American Agriculturist Foundation Scholarship. Six scholarships of $200 each are provided each year by the American Agriculturist Foundation, Inc. Students entering or in any class in the College of Agriculture and Life Sciences are eligible. The selection will be based on character, scholastic record, and financial need with preference given to students transferring from two-year colleges.

Babcock Poultry and Business Scholarship. Babcock Poultry Farms, Inc., provides one annual scholarship of $500 to a student majoring in poultry science (or with a poultry background), with plans for further study in business management. Preference will be given to entering freshmen. If the recipient of the award later decides to double register in his senior year in the Graduate School of Business and Public Administration he will then receive an additional $500.

Beatty Agricultural Scholarship. The Beatty Agricultural Scholarship fund, a gift of the late Harrison L. Beatty, provides a scholarship of approximately $300 to a student entering the College of Agriculture and Life Sciences from the Town of Bainbridge or from Chenango County. Grades in Regents Examinations receive major consideration in making the award.

Arthur Boller Memorial Scholarship. An endowment fund in honor of Arthur Boller, long time manager of the Cohn Fruit Farm, has been established by the H. M. Cohn Foundation to provide scholarship support for students interested in agriculture, especially fruit production and marketing. Preference will be given to students from developing countries and in addition, to black students who have demonstrated an interest in the areas stated above.

Broome-Tioga ABC Scholarship. An endowment fund established by the Broome-Tioga Dairy Cattle Artificial Breeding Cooperative provides one annual scholarship to a deserving student exhibiting interest in pursuing studies and professional application in husbandry practices related to dairy cattle. Selection is also based on character, scholarship, and financial need of the student. Preference

will be given to students from Broome County, New York, and Susquehanna County, Pennsylvania. Interested and qualified students should so indicate on their scholarship application.

The Henry H. Buckley Student Aid Fund is provided by the Henry H. Buckley Foundation in memory of Mr. Buckley, a well-known farmer of Oneonta, New York, who died in 1942. The purpose is to aid worthy students, of any class, who need financial assistance. In making awards, preference will first be given to applicants from Delaware County, and next, to those from Chenango, Herkimer, Madison, Montgomery, Oneida, Otsego, and Schoharie Counties.

Walter R. Clarke Memorial Endowment in memory of Mr. Clarke, a prominent fruit farmer who lived at Milton, New York, provides a scholarship of $150 each year for a student, of any class, in the College of Agriculture and Life Sciences who is primarily interested in fruit growing. Promise of successful work in this field is the basis for an award. Preference is given to students from the Hudson Valley area.

Continental Grain Foundation Scholarships. The Continental Grain Foundation has established three annual scholarships aimed at assisting students studying in the field of agricultural business. The awards are as follows: one award of $600 to a junior or senior in the College, a second award of $600 to a senior who is jointly registered with the Graduate School of Business and Public Administration, and a third award of $1,200 to a student who is jointly registered for the first year with the Graduate School of Business and Public Administration and who will receive the scholarship during his second year. Selection is based on character, scholastic record, and financial need.

Cornell Argentine Exchange Scholarship. A male freshman is chosen each May to spend a year at the University of Buenos Aires. Most expenses, other than transportation, are paid by the sponsors in Argentina. In exchange, a student enrolled with the Faculty of Agronomy and Veterinary of the University of Buenos Aires is chosen to come to Cornell to study for one year in the College of Agriculture and Life Sciences. His expenses here are paid by the Office of International Students, the College, and students.

Information is available at the Office of Resident Instruction. To be eligible, a freshman must have an average of C+ or above and must file an application by the end of the first week in April. The selection is made by a student-faculty committee.

Cornell-Mexican Exchange Scholarship. This exchange with the Instituto Technologico y de Estudios Superiores de Monterrey provides an opportunity for a male junior to spend a year studying at an outstanding technical university in Mexico. The out-of-pocket cost to the Cornell student is estimated at $1,000 for transportation, books, and personal expenses. The balance is covered by scholarships from the College of Agriculture and Life Sciences and Monterrey Tech, and by a contribution from the Mexican student coming to Cornell.

In exchange a Mexican student chosen by the Monterrey Tech comes to Cornell to study for one year in the College of Agriculture and Life Sciences. A comparable part of his expenses are paid by the College and by students.

Information is available at the Office of Resident Instruction. To be eligible, a freshman must have an average of C+ or above and must file an application by the end of the first week in April. The selection is made by a student-faculty committee.

The Cornell Pomology Club Scholarship or Grant-in-Aid of $400 each year is awarded to a sophomore, junior, or senior student who is specializing in pomology or has major interest in that field. Scholarship and financial need receive equal consideration in making awards, and qualified students are eligible for awards in succeeding years.

Cornell-Swedish Exchange Scholarship. A sophomore is chosen each year to spend his third college year at the Agricultural College of Sweden, Ultuna, Sweden. All expenses except transportation are paid by the Swedish students. In exchange a student from the Agricultural College of Sweden is chosen to come to Cornell, and the students of the College of Agriculture and Life Sciences pay the expenses.

Information and application blanks are available at the Office of Resident Instruction. To be eligible, a sophomore must have an average of C+ or above, and must file an application by the end of the first week in January. The selection is made by a student-faculty committee early in February.

J. Carlton Corwith Memorial Scholarships. The endowment fund which supports these scholarships was provided as a memorial to Mr. and Mrs. Corwith by their family, by friends and business colleagues, and by organizations which they had served. The awards are made to men and women of any class who have demonstrated an interest in careers related to the broad field of agriculture. Selection is based on character, scholastic achievement, potential for leadership in agriculture, and financial need.

Dairylea Cooperative Scholarship. The Dairymen's League Cooperative Association, Inc., provides a $500 scholarship each year for a student who has completed two years in the College with a demonstrated interest in dairy technology or dairy marketing. In addition, students who have completed three years and who are preregistered for student teaching courses in preparation for teaching agriculture in high school are also considered. The final selection is based on character, scholastic record, and financial need, with preference being given to the student who is most likely to make a contribution to agricultural education, dairy marketing, or dairy technology.

The William Frederick Dreer Fund, from the estate of William Frederick Dreer, has been established to provide a worthy student, specializing in floriculture or ornamental horticulture, an opportunity for study and directed practice in foreign countries for approximately one year. The award is approximately $3,000 and is available to either an undergraduate or graduate student within the period of his college course or upon its conclusion. Scholarship, character, maturity, seriousness of purpose, and promise of ability to make contributions to his field are considered in making awards. Applications should be on file at the Office of the Department of Floriculture and Ornamental Horticulture by December 1 preceding the June in which travel will start.

The Leonard A. Dudley Scholarship Endowment was established by gifts from Leonard A. Dudley of Binghamton, New York. The income from the fund provides scholarships for members of any class in the College of Agriculture and Life Sciences. Awards are made to deserving men or women with demonstrated financial need who are specializing in agricultural engineering, agricultural business, or agricultural science.

In selecting recipients, the Scholarship Committee gives first preference to students from Broome County and second preference to students from Tioga, Cortland, Chenango, and Delaware Counties.

Eastern Milk Producers Cooperative Scholarships. Three annual scholarships of $250 each are provided by the Eastern Milk Producers Cooperative Association, Inc. Their purpose is to assist worthy students of any class in the College of Agriculture and Life Sciences with preference to be given to students who are certified as sons or daughters of members of Eastern Milk Producers Cooperative Association. In order to qualify, students must rank in the upper two-fifths of their high school graduating class or of their class in college. They must also establish a need for financial assistance and show evidence of outstanding character and leadership ability.

Federated Garden Clubs of New York State Scholarships. Two annual scholarships of $250 are provided by the Federated Garden Clubs of New York State, Inc. They may be awarded to worthy four-year students in any class who are residents of New York State, who intend to specialize in floriculture and ornamental horticulture, and who are of good moral character. Both need and scholastic promise are considered in selecting the recipients.

General Foods Fund Scholarships. The General Foods Fund, Inc., has provided four scholarships for freshmen. The scholarships are for one year and are valued at $400 each. In making the selection, two scholarships will be given to students specializing in food science, and two to students specializing in agricultural engineering, biochemistry, biological science, or microbiology.

Gerber Scholarship in Horticulture. The

Gerber Baby Foods Fund, Fremont, Michigan has established an annual scholarship of $500. The scholarship will be awarded to a resident of New York State who will be enrolled as an upperclassman in the College of Agriculture and Life Sciences. The selection will be based on character, promise for leadership in horticulture and with equal consideration given to scholarship and financial need. In making the selection, preference will be given to students specializing in agronomy, entomology, plant pathology, pomology, and vegetable crops. The application should substantiate the applicant's interest in horticulture.

Heatley Green Scholarship. The Heatley Green Scholarship Endowment was established under the will of Mrs. Green in memory of her husband, who had been a New York State farm boy and was a graduate of the College of Engineering at Cornell in the class of 1901. Mr. Green believed strongly in property training for successful farming, and this scholarship is used to help and encourage worthy undergraduate students of moderate means. Awards are on an annual basis and may be made to one student or divided between two or more students of any class in the College of Agriculture and Life Sciences.

The Hervey S. Hall Scholarship, established by bequest of Miss Mary F. Hall of Spencer, New York, and having an annual value of $150, is awarded to a properly qualified student of either sex, a resident of New York State pursuing a course in agriculture leading to the degree of Bachelor of Science, and in need of financial aid. It is "to be granted first to a student from the town of Spencer, New York, should a suitable candidate appear, or a student from Tioga County, or from the State at large."

The Annie M. Hatch Indian Scholarship Endowment, established by a gift from Annie M. Hatch, supports scholarships and grants-in-aid to needy students enrolled in any class in the College of Agriculture and Life Sciences. Preference will always be given to applications from New York State Indians.

H. J. Heinz Scholarships. The H. J. Heinz Company has provided two scholarships for students participating in the Food Industry Management Program. One is for $1,100 and the other for $800. An additional $600 has been provided to expand the Program. The awards are made on the basis of scholastic achievement or promise, character, financial need, and the student's desire to pursue a career in the food industry. They are not available to students on leave of absence from food companies.

Frederick F. Horton Scholarship. This endowment in honor of Frederick F. Horton who was Experimentalist in the Department of Floriculture and Ornamental Horticulture for forty-one years was established by his friends and by former graduate students in the Department. The income supports an annual award for undergraduate students specializing in floriculture. Selection of the recipient will be based on academic ability, character, need for financial assistance, and promise for future leadership in floriculture.

Alfred C. Hottes Amateur Gardening Scholarship. The Alfred C. Hottes Amateur Gardening Scholarship Fund, a gift of the late Alfred C. Hottes, provides one or two scholarships of $300. Eligible candidates are undergraduate students in the College of Agriculture and Life Sciences who, by reason of their academic records, character, and activities, show promise of advancing through their study and work the subject of floriculture and ornamental horticulture as an amateur activity. In the application each applicant should point out how he might be expected to do this.

John P. Houck Memorial Scholarship of the NFBA Foundation, Inc. The National Food Brokers Association Foundation, Inc., has made available this scholarship from contributions of M. W. Houck, Inc., of Bronxville, New York. The scholarship is provided for students participating in the Food Distribution Program. The value of the scholarship is $1,000. The award is made on the basis of scholastic achievement, financial need, character, and the student's desire to pursue a career in the food industry.

The Burton A. Jennings Memorial Endowment Fund was established in memory of Professor Emeritus Burton A. Jennings, a faculty member of the Department of Agricultural Engineering from 1922 until his retirement in 1958. Income from the

fund is to provide a scholarship or grant-in-aid for a deserving student. First preference is given to a student specializing in agricultural engineering who has completed the sophomore year.

Jewel Foundation Scholarships. The Jewel Foundation has established two $500 scholarships. One scholarship will be awarded to a senior specializing in food industry management who has a career objective in the food industry. The second scholarship will be awarded at the end of the senior year to a student specializing in food industry management with a career objective in the food industry, and who is pursuing the combined course in the Graduate School of Business and Public Administration.

The David Kennedy Johnston Endowment Fund, established by a bequest under the will of Nettie J. Huey, provides scholarships and grants-in-aid for worthy students entering the College, or already enrolled, and specializing in animal science. Preference is given to residents of Venango County, Pennsylvania.

Carl E. Ladd Memorial Scholarships. A fund in memory of Carl E. Ladd, Dean of the College from 1932 until his death in 1943, provides a number of scholarships which are open to young men and women from New York farms who are members of any class in the College of Agriculture and Life Sciences. The awards are made on the basis of character, financial need, promise for future leadership, and school record.

The George LaMont Educational Fund was established in gifts from George B. LaMont and his son T. E. LaMont, both deceased, who were owners of the LaMont Fruit Farm in Albion, Orleans County, New York. The income from the fund provides one or two scholarships, for Orleans County farm boys of good moral character, who have a record in school and out that shows ability and application, and who are in need of financial assistance. Awards are for one year and usually are made only to young men entering college.

Marion A. and A. Percy Leon Foundation Scholarship. The Foundation supports two scholarships of $500 each through annual grants. Undergraduate students of good character and with commendable academic achievement who are in need of financial assistance are eligible for these awards.

The Wilhelmine Lind Memorial Scholarship, given by Mrs. Hollis Cornell in memory of her close friend Wilhelmine Lind, provides an annual award of $1,000. As expressed by the founder, the award shall be made to "a woman of fine character, specializing in floriculture, who is also capable, needy of financial assistance, and deserving." The same person may receive the scholarship for more than one year. Recommendations for this award are made by the Department of Floriculture and Ornamental Horticulture.

Loblaw Scholarships. Loblaw Incorporated provides two scholarships of $500 to be granted to freshmen students in the Food Industry Management Program each year. The scholarships may be retained during four years of undergraduate study provided that the students' academic records are satisfactory.

The awards are based on financial need, character, and scholastic record. Preference will be given to employees and children of employees of Loblaw Incorporated. Applicants must identify this relationship on the financial aid section of the application for admission and verification from the personnel department of Loblaw Incorporated must be attached.

Hudson H. Lyon Memorial Scholarship. The endowment for this scholarship fund was established by the late H. H. Lyon of Bainbridge, New York. The income, amounting to about $1,600 a year, is to be used to aid students who are preparing for Protestant Christian missionary service, with perference to those who include agriculture in their training.

The Robert N. Marshall Memorial Poultry Scholarship fund, given by friends of Robert N. Marshall, a prominent poultryman, provides an annual scholarship or grant-in-aid to help a deserving student. In making the selection, first preference is given to an entering freshman who intends to specialize in poultry science. Otherwise, it is to go to an upperclassman in the Department of Poultry Science.

The Frank W. Mason Agricultural Scholarship was established by gifts from the late Frank W. Mason, a prominent fruit

farmer of Albion, Orleans County, New York. The income provides an annual scholarship for a young man or woman from Orleans County, with preference given to graduates of the Albion Central School and those who are interested in fruit growing or marketing. In making awards, consideration is given to need for financial assistance, academic ability, moral character, and promise for future leadership in the broad relationships of agriculture.

Oscar Mayer Scholarships. The Oscar Mayer Foundation Inc. has established two $1,000 scholarships for students specializing in Food Industry Management. The scholarships are to be awarded on the basis of character, scholarship and a career interest in the food industry.

W. S. Middaugh–Alpha Zeta Memorial Scholarship. In order to recognize those students dedicated to making a real contribution to agricultural business or international agriculture, this scholarship of $500 is granted in memory of Wessels S. Middaugh, '26, who dedicated his life to service through a career in international agriculture. The award is made to a student who ranks in the upper two-fifths of his class, is of good character, and who has demonstrated leadership ability. Financial need is not considered. Preference is given to members of Alpha Zeta, the national professional agricultural honorary fraternity. Ordinarily, the award is made at the end of the junior year.

Frank B. Morrison Memorial Scholarships. An endowment fund, established by Mrs. Frank B. Morrison in memory of her husband, a former head of the Department of Animal Science, provides two or more annual awards of $300 each. They are made to juniors or seniors of outstanding ability whose major interests are in animal science. A committee from the faculty of the Department of Animal Science considers both academic achievement and personal qualities of leadership and character in recommending awards.

H. B. Munger Memorial Endowment. This memorial to H. B. Munger was initiated by the Farm Credit Banks of Springfield with which he was affiliated from 1934 to 1952. Contributions to the fund came from organizations, friends, family, and colleagues. The income supports one or more scholarships for students specializing in some field of agriculture or agribusiness. In selecting recipients, scholastic achievement, character, leadership potential and financial need will be considered.

New York Farmers Scholarships. This fund is provided by the New York Farmers for the purpose of assisting young men with good ability, who need financial aid, to continue their agricultural education. Preference in making awards will be given to farm boys, those who wish to farm, and those who expect to serve farmers directly.

New York Lime Association Scholarships. The New York Lime Association provides $1,200 each year for scholarships to be awarded to members of the three upper classes. In selecting students for awards, major interest in agronomy, scholastic achievement especially in the sciences, potential ability for leadership, and need for financial assistance are considered, with preference being given to residents of New York State. The awards are normally given for one year but may be renewed if the student qualifies in competition with other members of his class.

Alfred M. S. Pridham Scholarship. The New York State Nurserymen's Association provides an annual award of $500 to encourage outstanding undergraduate students of good character with limited financial means. Preference is given to those who are specializing in ornamental horticulture (growing, wholesaling, retailing, or educational fields) and/or landscape design. A student in any class may receive the award on the recommendation of the Department of Floriculture and Ornamental Horticulture.

Ralston Purina Aids to Education. The Ralston Purina Company has provided the following two scholarships: *Ralston Purina Scholarship:* The Company offers an annual scholarship of $500 to an outstanding undergraduate student in agriculture. The award is made each year to a student who will be entering his senior year or, under unusual circumstances, his junior year. The recipient must rank in the upper 25 percent of his class scholastically. Evidence of leadership ability, moral character, participation in extracurricular affairs, sincerity of purpose, and financial need are taken into

account in making an award. *Danforth Leadership Training Scholarship for Agricultural Freshmen:* An outstanding freshman is selected to represent the College at Camp Miniwanca, Stony Lake, Michigan. He joins freshmen from other U.S. Land-Grant Colleges and from three Canadian agricultural colleges for two weeks of leadership training in August. Full tuition is paid by the Ralston Purina Company. The selection is made in May from those freshmen with outstanding records in the fall semester.

The Roberts Scholarship Fund, a gift of the late Dr. Charles H. Roberts, of Oakes, Ulster County, New York, provides five scholarships, each retainable for one year, but not open to entering students. As expressed by the founder, the purpose of these scholarships is to furnish financial assistance to students in the College of Agriculture and Life Sciences who are of good moral character, who show native ability, tact, and application, and who are in need of such assistance, especially students coming from rural districts. The awards are made after the close of each year.

The Aaron H. Rubenfeld Memorial Scholarship was established by the Middletown Milk & Cream and Dellwood Dairy Divisions of Deltown Foods, Inc., of Yonkers, New York, in memory of their late president and founder, who believed in actively encouraging progress in the dairy industry. Candidates for this $500 award must have completed their sophomore year in the College, must show evidence of need for the financial assistance, must have demonstrated interest in the dairy industry, and must possess characteristics that indicate potential ability to contribute to improvement in the production, marketing, and manufacture of milk and milk products. With other qualifications equal, preference will be given to children of employees of either of these two companies and of producers shipping their milk to Middletown Milk & Cream Division or its affiliates. Payment of $125 is made to the recipient at the beginning of each semester in the junior and senior year.

C. W. Sadd Memorial Scholarship. The endowment fund which supports this scholarship was provided as a memorial to Mr. C. W. Sadd by his family, by friends and business colleagues, and by organizations which he had served. The award is made to men and women of any class who have demonstrated an interest in careers related to food distribution, marketing, and business management. Selection is based on character, scholastic achievement, and potential for leadership in business.

Seneca-Wayne Eastern A. I. Cooperative Scholarship. An endowment fund established by the Seneca-Wayne Eastern A. I. Cooperative provides one annual scholarship to a deserving student from Seneca or Wayne County. Preference will be given to sons or daughters of members of this Cooperative. Students must indicate this information on their scholarship application. Further preference will be given to students with an interest in the broad field of dairying, including, but not restricted to, dairy farming or any of the related industries. Selection will be based on character, financial need, scholarship, and potential for leadership in the dairy industry.

Lansing P. Shield Memorial Scholarships. Four $500 scholarships have been made available by the International Foundation to Improve Distribution Methods, Inc., in honor of its founder, Mr. Lansing P. Shield, president of the Grand Union Company, East Paterson, New Jersey. Scholarships are awarded to students with well-defined career goals in food industry management on the basis of character, innovation, financial need, and academic record.

Leland Spencer Dairy Marketing Research Fund Scholarship. The Dairy Marketing Research Fund has established this scholarship in recognition of Professor Emeritus Leland Spencer and his contributions in the dairy marketing field. The scholarship is available to an undergraduate student in the New York State College of Agriculture and Life Sciences who has demonstrated his potential for making a contribution in the field of dairy marketing. In selecting recipients, the Scholarship Committee will give special consideration to those who have completed the work of the junior year; have achieved a rank in the upper third of their class; have taken courses in dairy marketing, dairy industry, dairy husbandry, and farm management; or have otherwise demonstrated a special interest

in the area of dairy marketing.

Ward W. Stevens Holstein Scholarship. A fund in honor of Ward W. Stevens provides a scholarship to a male undergraduate student in the College of Agriculture and Life Sciences who has completed at least one-half of his course. It may be awarded to one student or divided among several students. A student who has held the scholarship is eligible to reapply. The award is based on character, exceptional ability in the judging and handling of dairy cattle, high scholastic rank in dairy husbandry courses, need of financial assistance, and special interest in the Holstein breed of cattle.

Turnstyle Retailing Scholarship. The Turnstyle Corporation, a Jewel Company, has established a $500 scholarship. It will be awarded to a senior specializing in food industry management with a career objective and potential for management in retailing. The award is made on the basis of character, scholarship, financial need, and promise for future management ability.

Ullman Scholarship Fund. The residue of a trust fund established by S. Edward Ullman supports a scholarship or scholarships for students pursuing as a specialty the study of forestry. The recipients are chosen each year on the recommendation of the professors (not assistant professors) of forestry in the Department of Natural Resources.

The May Walker Agricultural Scholarship Fund was established under the will of May Walker in gratitude for the assistance given her by the University in 1919 and 1920. An award will be made by the Scholarship Committee for the benefit of a student from the United Kingdom or the British Commonwealth who is attending the College of Agriculture and Life Sciences. The applicant must clarify his place of residence on the application form.

Woman's National Farm and Garden Association Scholarships. The New York State division of this Association has provided the following two scholarships: *A Scholarship in Honor of Its First President, Mrs. Francis King* ($250) is awarded biennially to a woman of the sophomore class in the College of Agriculture and Life Sciences, who is then given preference for the award in her junior year. Character, interest in agriculture, scholarship, and financial need are considered. *A Scholarship in Memory of Its Former Honorary President, Mrs. Walter Douglas* ($200) is available to junior or senior women in the College who have achieved high standing. Character and financial need are considered, with preference given to girls who have been active in a 4-H Club.

Gary Zien Scholarship Award. Funds for this $200 scholarship are provided by a former Food Industry Management scholarship holder who was graduated with the class of 1964. Selection is based on financial need, potential for management, and scholastic record. Available only to undergraduates majoring in food industry management.

Scholarships for Nonresidents. Twenty tuition scholarships are available for nonresidents of the State. They are awarded annually, and evidence of need is required.

Other Scholarships. Information about other scholarships open under certain conditions to undergraduates in the College of Agriculture and Life Sciences may be obtained in the Office of Scholarships and Financial Aid, Day Hall.

Awards

Alpha Zeta Scholarship Key. The Alpha Zeta Fraternity presents a scholarship key to the student who made the highest scholastic average in the first year of the four-year course. The name of the recipient is also inscribed on a plaque in the Office of Resident Instruction. The key is presented at the annual barbecue in the fall.

Alumni Prizes. The Alumni Association of the College of Agriculture and Life Sciences provides two annual prizes of $50. These are awarded by the faculty, one to the junior who had the highest cumulative average at the end of the sophomore year, and one to the senior who had the highest cumulative average at the end of the junior year.

Burpee Award in Horticulture. An annual award of $100 is made possible through a grant from the W. Atlee Burpee Company, Seed Growers, Philadelphia, Penn-

sylvania, and Clinton, Iowa. The purpose is to encourage outstanding students in the study of vegetable growing and flower growing. The award is made at the beginning of the senior year and is divided equally between two students, one in the field of floriculture and ornamental horticulture and the other in vegetable crop production. To be eligible, the student shall have completed Biological Sciences 240 or its equivalent, and at least two courses in the department concerned, and shall have signified intention of specializing in that department.

Eastman-Rice Prizes for Public Speaking ($100, $50, and $25) are awarded by a committee of judges to any regular or special student in the College of Agriculture and Life Sciences for public speaking on topics of their choice. Elimination contests are held beginning approximately December 1, with the final contest taking place during the spring semester. Contestants sign up before December 1 in the Communication Arts Office, 510 Mann Hall, where additional information may be obtained.

The Paul R. Guldin Memorial Endowment, established by Mrs. Paul R. Guldin as a memorial to her husband, a graduate of the College in 1912, is to encourage undergraduate students in the Colleges of Agriculture and Life Sciences and Human Ecology to become interested, and to take part, in the development of a more adequate rural leadership. The income supports a contest for the best original articles or stories, written by undergraduates in these Colleges and published in the *Cornell Countryman,* that contribute to the purpose of the endowment. The awards will be made twice a year, the first award being based on the articles in the October, November, December, and January issues and the second awards on the February, March, April, and May issues. In each instance the awards will be $75 for first place, $50 for second place, $25 for third place, and $10 for honorable mention. The selection will be made by a committee from the faculty appointed by the Dean.

The Frank B. Morrison Memorial Prizes, totaling $100 annually, are given to students winning top awards in the Students' Fitting and Showmanship Contest.

New York Florists' Club Awards in Floriculture. Three annual awards are made possible through a grant from the New York Florists' Club, New York, New York.

The award for $200 is to encourage outstanding students in commercial floriculture (growing, wholesaling, retailing, or educational fields). To be eligible the student shall have a specialization in commercial floriculture and shall have completed the junior year. The award shall be based on the combined average of all courses taken in the University, as well as interest in, and potential for, continuation in the field of commercial floriculture. The award will be made at the beginning of the senior year by the Faculty Committee on Scholarships on recommendations of the Department of Floriculture and Ornamental Horticulture.

The award of $150 is to recognize and encourage an outstanding undergraduate student specializing in any subject area in the Department of Floriculture and Ornamental Horticulture. He should have demonstrated exceptional interest, enthusiasm, and leadership and should have given distinguished service to the Department. Academic standing although important, is not the primary criterion. The award will ordinarily be given to an upperclassman.

The award of $100 is also given to any undergraduate student within the Department who has given distinguished service.

The Charles Lathrop Pack Foundation Forestry Prize of $100 is awarded annually in April for the best essay on forestry submitted by a resident student who has taken some course in forestry during the current college year. The purpose of the prize is to aid in training men and women to write articles that will arouse in the public an interest in forestry and an appreciation of what forestry means to the country. The award is made by a committee appointed by the President of the University. The detailed regulations are furnished by the Department of Natural Resources. The essay must be deposited at the office of the head of that Department by noon on April 15.

The Ring Memorial Fund was established under the will of Charles A. Ring to advance horticultural science. The income is used for a prize of approximately $50 to be awarded to an outstanding sophomore student specializing in plant or horticultural science.

Instructors and advisers of students in the plant sciences are requested to nominate, in writing, sophomores who show promise of advancing horticultural science. Consideration is to be given to grades in horticultural and supporting science courses; attitude toward education, horticulture, and scientific work; demonstrated ability for leadership; and character and personality. Nominations must be received at the Office of Resident Instruction before May 1.

The Samuel L. Stewart Prize of $100 is offered annually in an essay contest, to promote the production and distribution of high-quality milk, and to acquaint producers and handlers with the factors which may affect its palatability. The contest is open to undergraduate students in the College of Agriculture and Life Sciences. Essays of 600 to 800 words must be filed at the Office of Resident Instruction by May 1.

Other Prizes. Information concerning other prizes open to students enrolled in the University is given in the booklet *Prize Competitions.* Copies may be obtained at the Visitor Information Center, Day Hall.

Loans

A fund contributed by students of the College is available for small, short-time, emergency loans. Applications may be made to the College Secretary.

A fund, the interest on which is available for loans to students specializing in floriculture, has been established by Mr. Max Schling of New York City. Another loan fund for students of floriculture, with principal and interest available, has been contributed by the New York Florists Club. Applications for loans from both these funds may be made to the College Secretary.

For other loan funds, available to students of all colleges at Cornell, application should be made at the Office of Scholarships and Financial Aid, Day Hall.

Facilities

Buildings

The buildings of the College of Agriculture and Life Sciences lie principally on the upper campus of Cornell University. There are sixteen buildings which house the classrooms of the College. The following buildings are located around the "Ag quadrangle" and contain the offices of the departments indicated:

Comstock Hall, entomology
Caldwell Hall, entomology
Warren Hall, agricultural economics and rural sociology
Stone Hall, education
Roberts Hall, communication arts
East Roberts Hall, extension
Plant Science Building, floriculture and ornamental horticulture, pomology, plant pathology, and vegetable crops

Buildings to the northwest and east of the quadrangle house other departmental offices and facilities of the College. They include:

Bradfield Hall, agronomy, plant breeding, genetics and development
Emerson Hall, agronomy, plant breeding
Fernow Hall, natural resources (conservation)
Rice Hall, poultry science
Savage Hall, nutrition
Stocking Hall, food science and microbiology
Riley-Robb Hall, agricultural engineering
Morrison Hall, animal science
Wing Hall, biochemistry and molecular biology

As far as possible, classes and laboratory exercises for courses offered in the sixteen departments of the College are conducted in the buildings in which the offices of the departments are located. However, in many instances this is impossible. The student should, therefore, consult the course descriptions in this *Announcement* in order to determine the location of each class or laboratory exercise.

In addition to the classroom buildings listed above, other facilities on the campus of the College include an auditorium (Bailey Hall), a fine modern library (Mann Library), new bioclimatic laboratories, sixteen greenhouses, a judging pavilion, and numerous special laboratories and barns.

Students in the College of Agriculture and Life Sciences take many courses in other colleges of the University, particularly in the College of Arts and Sciences. The buildings students use most frequently there include Goldwin Smith Hall for English and the humanities, Baker Lab-

oratory for chemistry, Rockefeller Hall for physics, Sibley Hall for government and history, Stimson Hall for ecology and systematics, and White Hall for mathematics.

Buildings of interest to all students in the university include the Uris Library for undergraduate study; Olin Library for graduate research; Gannett Medical Clinic; Willard Straight Hall and Noyes Student Center for social activities; Anabel Taylor Hall for Interfaith activities; Barton Hall, Helen Newman Hall, and Teagle Hall for physical education; Lynah Hall for ice skating; and Sage Chapel for interdenominational church services.

The offices of administration for the College of Agriculture and Life Sciences are located in Roberts Hall, and those for the general administration of the entire University are situated in Day Hall. The administrative center of student life in the College of Agriculture and Life Sciences is the Office of Resident Instruction located in Roberts Hall. All students, both prospective and already enrolled, are urged to visit this office for guidance on questions pertaining to undergraduate activities.

Lands for Research and Instruction

The New York State College of Agriculture and Life Sciences uses about 14,200 acres of land for its research program and for instructional purposes. About 71 percent of this land is owned by Cornell University, 23 percent is owned by New York State; the balance is leased or owned by other agencies or is on grower farms. Of the land owned by Cornell University, some 7,900 acres are in Tompkins County and about 2,100 acres outside the county. Of the state-owned land 1,116 acres are in Tompkins County and 2,235 acres outside the county. The land is used primarily by research workers of the Cornell University Agricultural Experiment Station (Ithaca) and the New York State Agricultural Experiment Station (Geneva), both of which are a part of the New York State College of Agriculture and Life Sciences.

The type and amount of land assigned to each department varies according to its needs. Some departments, such as Agronomy, Plant Breeding and Biometry, Floriculture and Ornamental Horticulture, Pomology, and Vegetable Crops, need tillable land with certain types of soil on which field experiments can be conducted. The Animal Science Department needs large areas suitable for pasture and for the production of hay, grain, and corn for silage to feed experimental animals in the dairy and beef cattle herds, sheep, and swine.

Arable land not immediately needed by the individual departments for research and instruction is operated by the Office of Farm Services. This office also acts as a service department, plowing and fitting some of the land used by other departments for experimental purposes. This system avoids the duplication of expensive machinery and uses the farm labor efficiently. The Departments of Animal Science, Agronomy, Plant Breeding and Biometry, Pomology, and Vegetable Crops, in order to facilitate cultivation of their large acreage, own their own equipment.

Of the 13,130 acres available for use by the Cornell University Agricultural Experiment Station at Ithaca, about 4,450 acres are in cropland and about 795 acres in pasture. There are more than 4,800 acres in woods used for research purposes and there are about 3,100 acres in additional lands, woods, and roads.

In addition to the land area located around Ithaca, there are research farms located as follows: the Long Island Vegetable Research Farm at Riverhead, a foundation seed potato farm near Lake Placid, a Cornell-USDA Nematode Research Farm in Steuben County, a fruit farm at Sodus, an agronomy farm at Aurora, and a 389-acre Biological Field Station on Oneida Lake. Also, test plots are located in a number of counties to evaluate the results of research under a variety of environmental conditions.

Of the 1,093 acres of land for the New York State Agricultural Experiment Station at Geneva, there are some 432 acres in fruit and 112 acres in vegetables. In addition to this, there are 28 acres of experimental grape vineyards and laboratory facilities at Fredonia in Chautauqua County and 19 acres of experimental land and laboratory facilities at Highland in Ulster County for research serving the fruit and vegetable industry in the Hudson Valley. In addition to these stations, re-

search is conducted on 305 acres of growers' farms in a number of different counties.

Libraries

The College of Agriculture and Life Sciences and the College of Human Ecology are served by the Albert R. Mann Library of more than 400 volumes. This is supplemented by the other libraries of Cornell University, containing over 3,800,000 volumes, many of which also relate directly to agricultural and human ecology subjects. In addition to materials on applied agriculture and human ecology, the Mann Library contains extensive collections dealing with such related sciences as botany, biochemistry, microbiology, genetics, entomology, and nutrition. It also includes large collections in economics, sociology, child psychology, and education, and smaller collections on a variety of other subjects. The numerous complete files of foreign and domestic periodicals and government publications, of which some 11,000 are received currently, are also of major importance.

The principal collection on entomology is in Comstock Hall. Small collections of reprints, bulletins, and duplicate books and journals are provided by several departments in their own buildings for use by their faculty and graduate students.

The Albert R. Mann Library building, completed in 1952, has a capacity of 500,000 volumes and 750 reading-room seats. The first floor is devoted primarily to books assigned for class reading, with rooms seating 425 persons. On this floor is a room for small groups studying together, and also the Ellis Room containing books and periodicals for leisure reading. On the second floor are the reference and bibliography rooms, periodical reading rooms, offices and work rooms, the main loan desk, and the card catalog. The catalog provides a record of the library materials in all libraries and departmental collections of the Colleges. The library has a comprehensive collection of bibliographies.

When the University is in session, the library is open, with librarians on duty to assist readers, seven days a week for a total of ninety-three hours of service each week. Students must present identification cards when borrowing books. Information on library regulations and suggestions for use of the library are provided all new students in orientation meetings each fall. More detailed information appears in booklets distributed at that time.

Housing and Dining

On Campus

Undergraduate Students. Cornell University provides on the campus, dormitory facilities for about 5,000 students. Dining service is provided in Willard Straight Hall, Noyes Lodge, Noyes Center, Martha Van Rensselaer cafeteria, Hughes Hall Dining and Sage Cafeteria (graduate students), and Stocking Hall (Dairy Bar) Cafeteria. Application forms for dormitory accommodations and housing policy information will be mailed to each candidate for admission as a freshman or a transfer student at the time of notification of provisional acceptance to the University.

All freshman students are required to live in University housing. Transfer students are not subject to this requirement. Applications for housing from transfer students are assigned to available space in order of their receipt. The University will make every effort to fill all requests for University housing from transfer students as space permits, but accommodation of all applicants cannot be guaranteed.

Graduate Students. The University has two residence halls especially for graduate students. The Sage Graduate Center accommodates 190 men and women; Cascadilla Hall houses 155 men and women. The dining service in the Sage Graduate Center is available to all graduate students and faculty. Graduate students who wish to apply for housing should write to the Department of Student Housing, 223 Day Hall, when their plans to enter the University are complete.

Married Students. The University, through the Department of Student Housing maintains apartment accommodations for some of its married students and their families. These are Cornell Quarters, Pleasant Grove Apartments, and Hasbrouck Apartments, with total housing for more than 400 families. All apartments are unfurnished. For further information and application, write the Department of Housing,

Hasbrouck Apartments, Pleasant Grove Road, Ithaca, New York 14850.

Off Campus

Off-campus housing is available in apartment buildings, in private homes, and in rooming houses. The University, as a service to students, maintains a bulletin-board listing of available rooms and apartments. Because available accommodations changes daily, it is not possible to provide lists. Inquiries may be addressed to the Department of Student Housing, 223 Day Hall.

Health Services and Medical Care

Health Services and medical care for students are centered in two Cornell facilities: the Gannett Medical Clinic (outpatient department) and the Sage Infirmary. Students are entitled to unlimited visits at the Clinic. Appointments with individual doctors at the Clinic may be made, if desired, by calling or coming in person; an acutely ill student will be seen promptly whether he has an appointment or not. Students are also entitled to laboratory and x-ray examinations indicated for diagnosis and treatment, hospitalization in the Sage Infirmary with medical care for a maximum of fourteen days each term, and emergency surgical care. The cost of these services is covered in the General Fee.

On a voluntary basis, insurance is available to supplement the services provided by the General Fee. For further details, including charges for special services, see the *Announcement of General Information.*

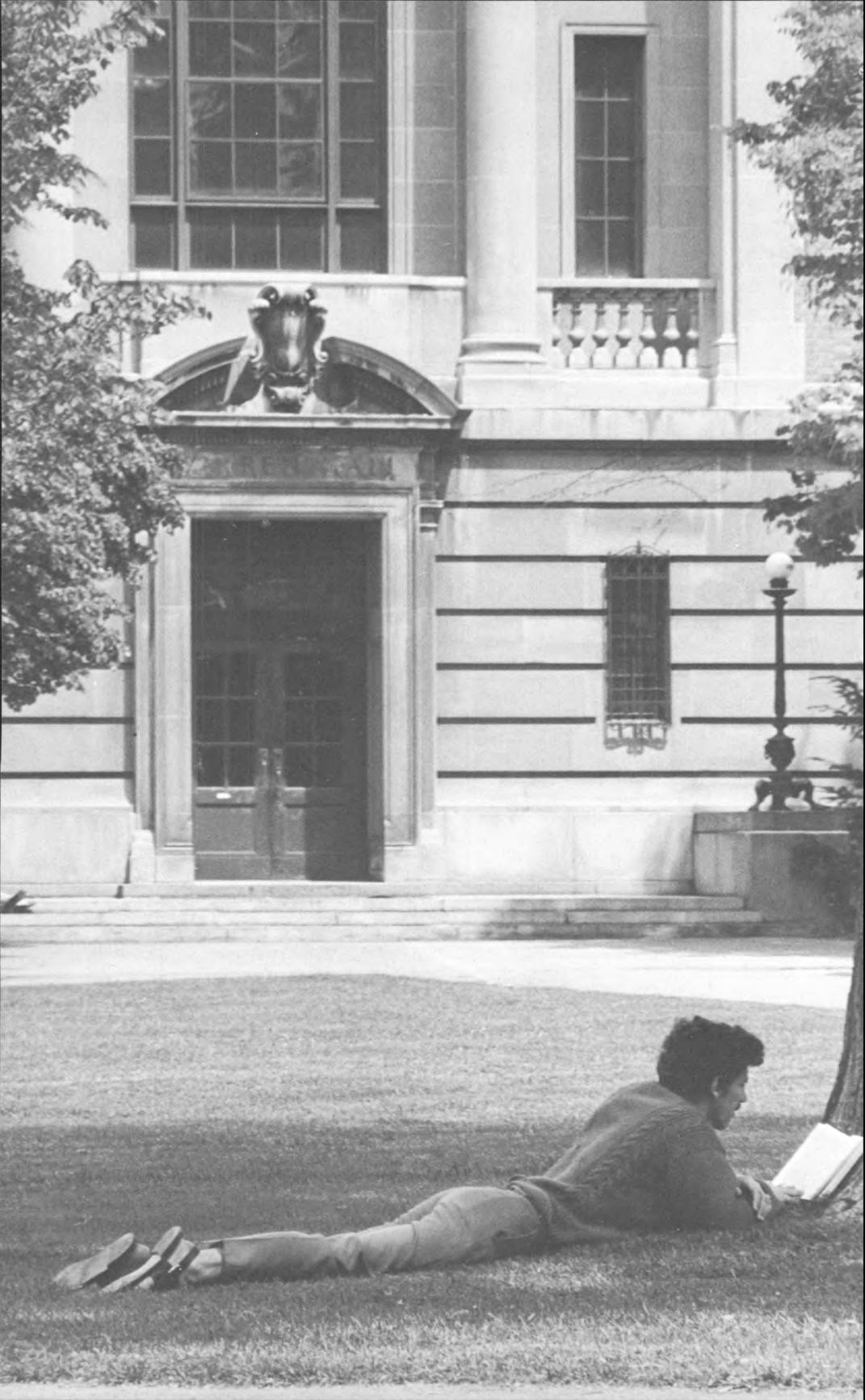
If, in the opinion of the University authorities, the student's health makes it unwise for him to remain in the University, he may be required to withdraw.

Placement Services

Placement services for graduating seniors and alumni are on a decentralized but coordinated basis. The University Career, Summer Plans, and Placement Center is available to all students and alumni of the University and is of most value to those students of the College of Agriculture and Life Sciences who are seeking positions in business, industry, government, or teaching. It serves all students and alumni of the University who are qualified for and interested in teaching or related positions in elementary and secondary schools and in colleges. College of Agriculture and Life Sciences graduates in the fields of science teaching and vocational agriculture teaching may be placed through the Center.

The Office of Resident Instruction of the College provides a service which combines vocational guidance and placement and is available to both students and alumni. Those interested in graduate study are referred to the appropriate departmental offices for further information and assistance. Placement in the Cooperative Extension Service is a function of the personnel officer in 4-H and agriculture extension.

Students and alumni also learn informally of employment opportunities through individual professors to whom requests may come because of their wide contacts with prospective employers throughout New York State.



Courses of Instruction

Courses numbered 100 through 199 are introductory courses primarily for freshmen and sophomores; courses numbered 200 through 299 are intermediate courses primarily for underclassmen; courses numbered 300 through 399 are advanced courses primarily for juniors and seniors; courses numbered 400 through 499 are primarily for seniors and graduate students; courses numbered 500 through 599 are primarily for graduate students; and courses numbered 600 through 699 are seminar courses. Unless otherwise noted, all courses are given in the buildings of the College of Agriculture and Life Sciences. Courses enclosed in brackets will not be given in 1971–72.

Grades A–F are used in the College. Also, S (Satisfactory) and U (Unsatisfactory) grades are given in courses where specified. College legislation restricts the use of S-U grades to upperclassmen who may receive one S-U grade per semester. Courses designated for S-U grade may not be in the student's specialization, nor may they be used to satisfy specific course and distribution requirements.

Orientation

1 English Tutorial. Fall or spring term. Noncredit. S-U grades only. Required of sophomores who matriculated as freshmen or one-year students and did not meet the English Proficiency requirement during their first year. Required of transfer students in their second semester if they have not met the English Proficiency requirement by the end of their first semester. Time and place to be arranged. Group tutorial course to help students write correct and effective English. Earning a grade of S constitutes satisfaction of the English Proficiency requirement.

5 Orientation. Fall or spring term. Credit three hours. The credit is not counted toward the 120 hours required for the degree. Fall term: for entering students only. M W F 8 (two sections) or 12:20 (two sections). Warren 160, 260. Spring term: may be elected by first-year students only. M W F 12:20. Warren 160. Instructor to be appointed.

Emphasis on the analysis and reasoning involved in the solution of verbal problems which have been drawn mainly from College of Agriculture and Life Sciences courses requiring the use of mathematics.

7 College Reading and Study Skills Program. Twice each term. Noncredit. S-U grades only. Program 1 starts at the beginning of fall term; Program 2, directly after Thanksgiving recess; Program 3, at beginning of spring term; and Program 4, directly after spring recess. Programs are open to all registered students. Registration takes place in Olin 375 during the insession week preceding the beginning of each program. Mr. Pauk.

Principles and techniques for more effective reading and studying are explained, demonstrated, and practiced in class. The reading laboratory provides an opportunity for increasing one's rate of reading.

101 Orientation. Fall term. Credit one hour. Required of students in the One-Year Curriculum in Agriculture. One lecture-discussion period a week. To be arranged. Instructor to be appointed.

110 Introductory College Mathematics. Fall or spring term. Credit four hours. Fall, T Th 8, F 1:25, M W F 8, 12:20. Laboratory, T or Th 12:20. Spring, M W F 8 or 12:20. Laboratory, T or Th 12:20. Warren 231. Mr. Geiselmann. Designed to give students with sound high school mathematics backgrounds a unified treatment of the basic concepts of college algebra, trigonometry, analytic geometry, and the elements of calculus. Considerable emphasis will be placed upon the concept of function, graphing, problem solving, and methods of proof. The Cornell University Computing Language (PL-C) will be taught and used to strengthen and integrate the mathematical topics covered in the course.

Agricultural Economics

The Department offers courses covering a wide range of subjects. Undergraduates interested in this field may specialize in agri-

cultural business management and marketing, agricultural economics, farm management and farm finance, food industry management, international agriculture, or resource economics. Course programs arranged with the help of faculty advisers may lead to employment on farms or in related industries or in public agencies serving agriculture in the United States or abroad, or prepare the student for advanced work beyond the B.S. degree.

Specialization in this Department may enable qualified students to enter the combined program with the College of Agriculture and Life Sciences and the Graduate School of Business and Public Administration leading to the M.B.A. or M.P.A. degree at the end of the fifth year. Undergraduates meeting college requirements may participate in the Honors program in the social sciences under the direction of a faculty member.

Farm Management

302 Farm Business Management. Spring term. Credit four hours. Not open to freshmen. Agricultural Economics 302 is a prerequisite for 402. Lectures, M W 10:10. Caldwell 100. One discussion period, F 9, 10, or 11. Laboratory, T W or Th 1:25–4:25. Warren 101. On days when farms are visited, the laboratory period is 1:25–5:30. One all-day trip and four half-day trips are taken to visit farm businesses. Mr. Conneman.

The course is focused on the intensive study of the problems associated with planning, organizing, operating, and managing a farm business. Emphasis is placed on the tools of managerial analysis and decision making. Principal topics considered include factors affecting profits, management information systems, business analysis, economic principles, complete and partial budgeting; acquisition, organization, and management of capital, labor, land, and machinery. The influence of technology and the contribution of related sciences and their importance to managers are covered.

402 Advanced Farm Business Management. Spring term. Credit three hours. Prerequisite: 302. Lecture, M W 10:10. Warren 101. Laboratory, W 1:25–4:25. Warren 260. On days farms are visited, the laboratory period is 1:25–5:30. Mr. Casler.

Emphasis is placed on evaluating the profitability of alternative investments and enterprises. Principal topics include linear programming, capital budgeting, influence of change on farm organization, financial risk and uncertainty. Experience in computer applications to farm business management is provided.

403 Cost Accounting for Farm Business Management. Fall term. Credit three hours. Prerequisite: 302. Lectures, M W 10:10. Laboratory, W 2:30–4:25. Warren 160. Mr. Kearl.

Cost-accounting methods and procedures for use in managing farms. Topics considered are the organization of accounts, methods of cost determination and allocation, summarization and analysis of accounts, making financial and operating statements, and using enterprise cost accounts to study the farm business and make management decisions.

405 Farm Finance. Spring term. Credit three hours. Prerequisite: 302. Lectures, T Th 10:10. Discussion, T 1:25–3:25. Warren 145. Mr. Smith.

A study of sound financial arrangements for farmers and the credit institutions which serve them. Emphasis is placed on problems of capital management associated with organizing and operating a commercial farm. Alternative sources of capital are analyzed and consideration given to safe and profitable debt levels and selection of alternative investment opportunities. Tax management, insurance programs, and retirement and estate planning for farmers are also studied.

406 Farm Appraisal. Fall term. Credit three hours. Prerequisite: 302. Lecture, T 10:10. Laboratory, T 1:25–4:25. Warren 101. On days when farms are visited, laboratory period is 1:25–5:30. Mr. Loomis.

A study of factors governing the price of farms, methods of farm valuation, and practice in the appraisal of farms.

508 Production Economics. Spring term. Credit three hours. Limited to seniors and graduate students. Prerequisite: Economics 102 or equivalent; Math 108 or Math 111 or equivalent suggested although not required. Lectures, T Th 11:15. Discussion, M 1:25–3:20. Warren 160. Mr. LaDue.

A comprehensive survey of production economic theory with emphasis on applications to agriculture and agribusiness. Topics covered include the derivation and use of production, cost, and supply functions.

Business Management

Attention is directed to courses in economics and mathematics in the College of Arts and Sciences and in administration in the Schools of Hotel Administration, Business and Public Administration, and Industrial and Labor Relations.

220 Introduction to Business Management. Fall term. Credit three hours. Lectures, T Th 8:30–9:55 or T Th 1:25–2:50. Warren 45. One preliminary examination will be given at 7:30 in the evening. Mr. Belden.

Emphasis will be placed on the role of business organizations in contemporary society and on the management of these organizations. Topics will include the relationship of business organizations to society; the impact

of external forces (stockholders, government, consumers, labor unions) on the organization; the principles of business management; and the functional areas (finance, marketing, production, personnel) of management.

221 Accounting. Spring term. Credit three hours. Lectures, M F 10:10. Warren 45. Laboratory: T W or Th 9:05–11:00 or 12:20–2:15. Warren 360. Mr. Eiler.
A comprehensive survey of basic accounting principles. Some analysis and interpretation of financial statements.

320 Business Law. Fall term. Credit three hours. Limited to upperclassmen. M W F 9:05. Plant Science 233. Mr. Bugliari.
Consideration is given chiefly to legal problems of particular interest to persons who expect to engage in business, with emphasis on the fields of personal property, contracts, agency real property, partnerships and corporations.

320H Business Law. Fall term. Credit four hours. Limited to upperclassmen with permission of the instructor. Lectures M W F 9:05. Plant Science 233. Discussion M 3:30. Warren 45. Mr. Bugliari.
The lecture portion of this course will cover the same material as 320. The discussion portion will deal with practical applications of certain of the legal principals covered in the course such as contract formation, real property transactions, incorporation and management of business enterprises, and attempt also to give some deeper insight into the role and function of the lawyer and the judiciary in our society.

321 Advanced Business Law. Spring term. Credit three hours. Prerequisite: 320 or its equivalent. T Th 8:30–9:55. Bache Auditorium. Mr. Bugliari.
Designed for those students who plan business careers in which a more detailed and comprehensive legal background could be utilized. Selected areas covered in 320 will be further developed, and particular consideration will be given to the law pertaining to bailments, sales, secured transactions, bankruptcy, negotiable instruments, insurance, and trusts and estates.

321H Advanced Business Law. Spring term. Credit four hours. Limited to upperclassmen with permission of the instructor. Lectures, T Th 8:30–9:55. Warren 45. Discussion T 3:30. Bache Auditorium. Mr. Bugliari.
The lecture portion of this course will cover the same material as 321. The discussion portion will deal with practical application of certain of the legal principals covered in the course, such as sales contracts, consumer protection, mortgage transactions, bankruptcy proceedings, negotiable paper, insurance, and drawing a will.

322 Taxation in Business and Personal Decision Making. Spring term. Credit three hours. Recommended prerequisites: at least one course in accounting (eg. Ag. Econ. 221) and a course in business law (Ag. Econ. 320). Th F 2:30–4:00. 233 Plant Science. Mr. Bugliari and Mr. Smith.
This course would deal with taxation both state and federal and its impact on business and personal decision making. State and local real property, income and sales taxes, and federal income and estate and gift taxes would be explored both as they affect individuals and corporations. Particular attention would be given to income tax management for operators of unincorporated businesses and smaller corporate firms. Both tax policy and the mechanics of taxation would be covered.

323 Managerial Accounting and Financial Management. Fall term. Credit three hours. Prerequisite: 220 and 221 or their equivalent. Lectures: T Th 10:10. Warren 245. Laboratories to be arranged. Mr. Brown.
The objective of the course is to provide an understanding of the most important financial concepts and methods of analysis needed by nonfinancial managers as well as others interested in lending to or investing in business firms. Emphasis is on solving problems and making decisions that are based on financial data. Topics include analysis of financial data, cost accounting, financial planning, methods of financing, and valuing business enterprises.

326 Farmers' Cooperatives. Spring term. Credit three hours. Not open to freshmen. M W F 9:05. Warren 145. Mr. Hedlund.
What cooperatives are, what they have tried to do, and what they have done; their legal status and special problems of organization, finance, and control.

324 Managerial Economics. Spring term. Credit three hours. Prerequisite: 221 and Economics 102 or their equivalents. Lectures, M W F 9:05. Warren 45. Discussions, W 2:30–4:25; Th 8–9:55, 10:10–12:05; Th 12:20–2:15; F 9:05–11:00 or 12:20–2:15. Warren 201. In weeks when discussions are held, there will be no Friday lecture. Mr. Aplin.
Emphasis is placed on identifying problems in a business, recognizing alternatives, and using economic data as guides to making decisions. The first part of the course focuses on cost analysis with emphasis on identifying costs relevant for various decisions within the firm. Opportunity costs and incremental analytical techniques are stressed. An introduction to linear programming is included. The second part of the course deals with the economic evaluation of proposed capital investment projects. Class discussion is supplemented by case studies to illustrate concepts and techniques available to management to assist in making sound decisions.

420 Introduction to Business. Fall term. Credit three hours. Lectures, M W F 12:20. Warren 101. Primarily for upperclassmen who are not majors in Agricultural Economics. May not be taken for credit by students who have taken 220 or 221. Mr. Belden.
The course is designed to acquaint students in other departments with the contemporary business organization. Topics will include the characteristics and structure of business activity, the role of business in production and marketing of goods and services as well as its role as a social institution, principles of managing an organization, the role of the natural scientist in business, and principles of accounting.

424 Managerial Decision Making. Spring term. Credit three hours. Limited to seniors with advisers in Agricultural Economics. T Th 8:30–9:55 or T Th 2:00–3.30. Warren 260. Mr. Earle.
An integrating course which examines business policy formulation and execution from the standpoint of the corporate manager. Designed as an advanced course for potential business managers and/or owners which will encompass the concepts and function of strategy, the nature of a company's environment, the interdependence of formulation and implementation of strategy, and the role of leadership in achieving business goals.

425 Personal Financial Management. Spring term. Credit one hour. Primarily for seniors. F 12:20. Bradfield 101. Mr. Smith and Mr. Brown.
Identification and analysis of problems in personal financial management common to young families. A study of income flows into the budget and financial demands on family resources. Personal income and budgeting, income tax management, consumer credit, asset acquisition, personal insurance programs, savings and investments, basic elements of retirement and estate planning.

425A Personal Financial Management Discussion. Spring term. Credit one hour. Must be taken concurrently with 425. Meets one hour each week. Time and place to be arranged. Mr. Smith and Mr. Brown.
Discussion of problems and case studies in financial planning for students and young families.

626 Seminar in Agricultural Cooperation. Spring term. Credit two hours. S-U grades optional. Open only to graduate students. Time and place to be arranged. Mr. Hedlund.
A discussion of the economic theory and function of farmer cooperatives. The place and contribution of cooperatives in developing and developed economies will be considered along with problems of structure, finance, management, and control.

Marketing and Food Industry Management

240 Marketing. Spring term. Credit three hours. Lecture, M W F 11:15. One discussion period only, during the first week of the term, M T W Th or F 2:30–4:25 or S 9:05–11. Warren 45. Mr. Goodrich.
A study of how products are marketed. Special attention is given to the consumption of food products, factors that affect consumption, market channels, operation of different marketing agencies, storage transportation, packaging, product identification, advertising and promotion, buying, selling, and costs.

346 Marketing Milk and Dairy Products. Fall term. Credit three hours. Lectures, M W F 11:15. Discussion, F 12:20. Warren 261. Mr. Story.
A review of the economic characteristics of the dairy industry, and an analysis of the marketing and pricing systems for market milk. Particular attention will be given to problems and resulting government programs, including marketing orders, price support operations, and public regulation of competition.

441 Food Distribution. Fall term. Credit three hours. Open to juniors, seniors, and graduate students. M W F 10:10. Warren 245. Mr. Earle.
A study of the structure and the competitive nature of the food industry. Particular attention is given to an analysis of the gross margin, expenses, earnings, and performance of food retailers. Government regulations with regard to mergers and buying and selling activities are examined. Leading food industry authorities frequently join the discussion session.

443 Food Industry Management. Spring term. Credit four hours. Open to juniors, seniors, and graduate students. M W F 10:10 and W 2–4:25. Warren 245. Mr. Earle.
A case study approach is used to examine the application of management principles and concepts to operating problems of food retailers. Areas included are site selection, buying, merchandising, personnel administration, private label products, and financing expansion programs. Leading food industry specialists frequently join the discussion session on Wednesday afternoons.

446 Economics of Food Marketing. Spring term. Credit three hours. Open only to seniors. Sections limited to 30 students. Prerequisite: 240 and Economics 311, or permission of instructor. M W F 9:05 or 11:15. Warren 260. Mr. Padberg.
A study of the organization of the agricultural marketing system and the nature of competition developing therein. Food industry structure and performance are appraised in light of current economic theory. Public regulation

of competition in food marketing is also covered.

449 Field Study of Marketing Institutions. Spring term. Credit two hours. Registration by permission. M 12:20. Warren 245. Mr. German.
Economic functions performed by various types of specialized marketing agencies, with emphasis on their physical operating patterns. Observations are made of the organization and operation of businesses in the food industry. Five days of spring vacation are spent in New York City and/or Boston visiting food distribution firms and marketing institutions.

540 Marketing Research. Spring term. Credit two hours. Permission of instructor required. Th 2:30–4:25. Warren 261. Mr. Brunk.
Objectives of marketing research, organization and management of research agencies, problem identification, selecting and planning projects. Special attention is given to the designing and use of research in the management of the marketing function.

541 Food Merchandising. Fall term. Credit two hours. Permission of instructor required. Th 2:30–4:25. Warren 260. Mr. Brunk.
A seminar exploring alternative merchandising and promotional devices for food industry retailers and manufacturers. Special attention is given to identification and measurement of basic forces having an impact on consumer buying behavior.

641 Marketing Economics. Fall term. Credit three hours. Open only to graduate students. T Th 12:20–2:15. Warren 261. Mr. Forker.
A study of marketing economics with special reference to agriculture. Designed to cover social as well as efficiency issues and criteria with respect to price and market organization. The application of economic theory (production and consumption economics) and quantitative methods to adjustment problems in the agricultural subsector. Includes topics on reformulation of the theory of the firm, economies of scale, theory of markets, economies of distribution, measurement of relative economic efficiencies, pricing in an imperfectly competitive market, market and price manipulation, marketing orders, and simulation.

642 Social Responsibility in Marketing. Spring term. Credit three hours. Open only to graduate students. T Th 12–2. Warren 261. Mr. Padberg.
A seminar course concerned with public policy in marketing. Concepts from industrial organization, consumer economics, and anti-trust are integrated in appraising public decisions in the marketing area. Examples are drawn primarily from analyses of the food marketing system.

Economics of Agricultural Development

350 Evaluating Environmental Quality. Spring term. Credit three hours. M W F 10:10. Warren 160. Mr. Chapman.
The first part of the course will introduce concepts of social value, social cost, and techniques of benefit-cost analysis. The latter part of the course will consider noneconomic methods of evaluation such as photography and naturalist essays. The class will make at least two field trips (at least one for a weekend). A paper or some other project of value to the whole class is expected from each student.

350A Ecological Aspects. Credit one hour. Prerequisite: Coregistration in 350. Discussion to be arranged. Mr. Wilkins (Department of Natural Resources) and Mr. Chapman.
An optional addition to 350. Intended to provide an opportunity for more intensive ecological background of environmental quality evaluation problems.

464 Economics of Agricultural Development. Spring term. Credit four hours. S-U grades optional. Prerequisite: 150 or Economics 101-102, or consent of the instructor. T Th 9:05 and W 7:30–9:25 p.m. Warren 345. Mr. Mellor.
An examination of the processes of economic development in the developing nations, and their interactions with United States policy. Rural development policy will receive primary attention because (1) the bulk of developing nations have a dominant agricultural sector, (2) agriculture has a key role to play in the overall economic transformation of these economies, and (3) interactions of United States Agricultural policy is a major component of total United States policy with respect to developing nations.

560 Food, Population, and Employment. Fall term. Credit four hours. Primarily for graduate students, but open to seniors with permission of the instructor. Prerequisite: at least two courses in economics. M W 1:30–3:30, plus an individual weekly meeting with the instructor. Warren 201. Mr. Poleman.
Designed to introduce students in the social and biological sciences to the relationships linking employment, food, and population growth in developing countries. Food economics is taken as the cornerstone: examined are human food requirements, the major food groups and their economic characteristics (including least-cost diet analysis and historical trends in food consumption), techniques of national food accounting (including data collection and evaluation), the projection of demand, and the disaggregation of data for analysis of particular problem groups and areas (notably the burgeoning number of urban dwellers and peasants bypassed by technological change). In treating the histori-

cal relationships between food and population, emphasis is placed on employment, income generation, and effective demand. Students are given ample opportunity to work with SAMI and other vital-rate monitoring devices. A term paper is expected.

665 Seminar on Latin American Agricultural Policy. Fall term. Credit three hours. Prerequisite: basic economics. Knowledge of Spanish or Portuguese is desirable. T 2:30–4:25, plus a weekly meeting with the instructor. Bradfield 105. Mr. Freebairn.
An examination of policies for the development of the agricultural sector in Latin America, including an identification of policy objectives and a review of the instruments of public policy implementation. Particular attention is paid to the contribution of research studies in agricultural policy formation and accomplishment.

668 Seminar in the Economics of Agricultural Development. Fall term. Credit two hours. S-U grades only. Open only to graduate students with permission. Time to be arranged. Messrs. Call, Conklin, Freebairn, Poleman, Sisler, Mellor, and other staff.
A joint exploration by the departmental staff in international agriculture of current topics in economic development with respect to agriculture. Intended primarily to facilitate the exchange of ideas among staff members, the seminar will be open to a limited number of advanced graduate students. Each student participant will be expected to prepare and defend a paper on a topic associated with his dissertation research.

669 Seminar on Agriculture and Economic Planning Models. Spring term. Credit three hours. Prerequisite: basic macro-economics and quantitative methods. T 12:20–2:20. Warren 361. Mr. Mellor.
The seminar will deal with planning models as applied to less developed economies and will emphasize the interaction between the agricultural and the nonagricultural sectors. The course will begin with discussion of one sector models of the Harrod-Domar type, proceed to deal with the labor surplus models such as the Lewis, the Fei-Ranis, and the Jorgensen models and then to the multi-sectoral models of the linear programming type. Finally, it will examine the models in the light of various questions related to planning such as balanced vs. unbalanced growth, choice of techniques, foreign trade, etc.

Public Policy

Attention is directed to course offerings in the Departments of Economics, Government, City and Regional Planning, Conservation, Civil Engineering, Consumer Economics and Public Policy, and the School of Business and Public Administration.

150 The Economics of Agricultural Geography. Fall term. Credit four hours. Lectures, M W F 9:05 or 11:15. Warren 45. Discussion, T W Th or F 2:30–4:25. Warren 245 and 345. Mr. Sisler.
The economics and geography of the world's agriculture, providing a basis for understanding past development and future changes in agriculture. Elementary economic principles, historical development, physical geography, and population growth are studied in their relation to agricultural development and the economic problems of farmers. Particular emphasis is placed upon study of the agriculture of various farming regions of the United States, their economic problems, and competitive situation.

330 Local Government. Fall term. Credit three hours. S-U grades optional. Lectures, T Th 9:05. Warren 145. Discussion, T 2:30–4:25. Warren 260. Mr. Lutz.
Government in the United States with emphasis upon examination, analysis, and resolution of public issues confronting leadership in areas of New York. Government organization, administration, functions, and finance are discussed in this context.

351 Agricultural Policy. Fall term. Credit three hours. S-U grades optional. Two lectures plus one discussion section each week. Lectures, T Th 9:05. Warren 245. Discussion sections, Th 11:15 or 1:25 or F 10:10. Warren 201. Mr. Robinson.
A review of the history of public policies affecting agriculture in the United States and an analysis of the economic effects of alternative farm policies or programs, either proposed or adopted. Among the topics discussed are farm price support and surplus disposal programs, trade policies affecting agriculture, alternative measures to alleviate rural poverty, and farm politics.

450 Resource Economics. Fall term. Credit three hours. Suggested prerequisite: Conservation 201 or consent of the instructor. Lectures, T Th 10:10. Bradfield 105. Discussion, T 1:25–3:25 and as arranged. Warren 160. Mr. Allee.
A review of the application of economic and political science concepts to problems in the use of natural resources including, but not restricted to, water, land, forests, and fisheries, with emphasis on the public management of the environment. Attention will be given to concepts of regional growth, the impact of urban growth, and public decision making in the resources area.

452 Studies in Regional Agricultural Development. Spring term. Credit four hours. Lecture, M W F 9:05. Warren 345. Discussion and field trips, Th or F 2–4:25. Warren 160. Mr. Conklin.
Practical procedures for appraising agricul-

tural development potentials and generating suggestions for agricultural development programs in regions smaller than nations. Treats physical, biological, economic, social, and political aspects from a point of view that is intermediate between the micro and macro levels traditionally recognized in economics. Examples are drawn from U. S. and foreign areas. Laboratory and field trips provide opportunities for practice and observation.

550 Economic Analysis of Public Investment. Spring term. Credit four hours. Primarily for graduate students, but open to seniors. Prerequisite: Economics 311 or 511, or consent of instructor. T Th 9:05–11. Warren 261. Mr. Kalter.
The application of economic theory and analysis to the governmental budgeting and expenditure process with emphasis on the welfare criteria of economic efficiency and income distribution. Techniques of benefit-cost analysis, equity analysis, systems analysis, and planning-programming-budgeting systems will be stressed. Discount rates, benefit estimation, externalities, multipliers, risk and uncertainty, and social welfare functions will be covered. Attention will be also focused on issues of cost sharing and reimbursement, and the way and means of intergovernmental payments.

552 Special Problems in Land Economics. Fall or spring term. Credit one or more hours. Open only to graduate students. Prerequisite: 452 and permission of the instructor. Mr. Allee and Mr. Conklin.
Special work on any subject in the field of land economics that is of particular interest to the student. The student normally is expected to prepare a report on his work that is suitable for mimeograph reproduction and distribution.

637 Administration of Public Agricultural Programs. Spring term. Credit two hours. S-U grades optional. Primarily for graduate students. Undergraduate registration by permission of the instructor. F 2:30–4:25. Warren 260. Mr. Lutz.
An examination of government organizations for administering and financing public agricultural programs; a study of some problems of administration and finance, including organization of agencies, management of personnel, budgetary management, interagency relationships (national, state, and local), and relationships among national, state, and local levels of government. Course 330 or one or more courses in government and public administration are desirable before taking this course.

650 Workshop on Resource Economics. Fall term. Credit variable, two to six hours. Open only to graduate students. Prerequisite: 550 or consent of instructor. T 3–5:30. Warren 261. Mr. Kalter and other staff.
The application of economic theory and analysis to governmental decision making with emphasis upon graduate students' research.

651 Seminar on Agricultural Policy. Spring term. Credit two hours. S-U grades optional. Open only to graduate students. M 1:30–3:30. Warren 245. Mr. Robinson.
A discussion of agricultural trade, price, and income-support policies and techniques appropriate to the analysis of policy issues.

652 Readings in Philosophy. Spring term. Credit three hours. Open only to Ph.D. candidates. S 9:05–12. Warren 260. Mr. Conklin.
Readings are selected for their relevance to research in agricultural economics and are chosen from among such books at *Structure of Scientific Revolutions, The Theory of Experimental Inference, The Nerves of Government, The Structure of Economic Science, Economic Philosophy,* and *Probability Statistics and Truth.*

Quantitative Methods

Attention is directed to related courses in Economics, Economic and Social Statistics (ILR), Industrial Engineering and Operations Research, Mathematics, and Statistics and Biometry; selected courses particularly relevant to agricultural economics are dual listed.

310 Introductory Statistics. Fall term. Credit three hours. Prerequisite: Orientation 110 or equivalent level of algebra. Lectures, T Th 11:15. Warren 45. Discussions: M T or W 1:25. Warren 145. Computing period in the afternoon or morning following the discussion, M T W 2:30 or T W Th 10:10. Warren 360. Mr. Mount.
An introduction to statistical inference including probability concepts, estimation, hypothesis testing, simple linear regression, and one-way analysis of variance.

Statistics II (Industrial and Labor Relations 311). Fall term. Credit four hours Prerequisite: one term of applied statistics or permission of the instructor.
An intermediate nonmathematical statistics course emphasizing the concepts associated with statistical methods. Topics include estimation and tests of hypotheses with applications involving means, variances, correlation coefficients, and an introduction to nonparametric methods, analysis of variance, and multiple regression.

412 Introduction to Quantitative Methods. Spring term. Credit three hours. Prerequisite: 310 or equivalent. Lecture, T Th 11:15. Warren 145. Discussion to be arranged. Instructor to be appointed.
An introduction to decision making under uncertainty, decision rules, inventory control, game theory, linear programming, and special linear programming problems. Primarily for

seniors and M. S. candidates; Ph.D. students should take course 512.

Matrix Algebra (Statistics and Biometry 417). Fall term. Credit three hours. Prerequisite: the equivalent of one year of college algebra. Lecture, M W F 9:05. Warren 201. Mr. Searle. Basic matrix algebra with applications in biology, business, economics, and statistics. Arithmetic procedures and other matrix operations; determinants, rank and linear independence, latent roots and vectors, solving linear equations, generalized inverses, direct sums and products. Use of matrices in regression analysis and linear statistical models.

510 Econometrics I. Spring term. Credit four hours. Prerequisite: ILR 311 (Statistics II) or equivalent; Statistics and Biometry 417 or equivalent suggested. Not open to undergraduates. Lectures: T Th 2:30–4. Warren 245. Mr. Tomek.
A comprehensive treatment of the classical regression model with selected extensions, including an introduction to simultaneous equations models and estimation methods, about at the level of *Econometric Methods* by J. Johnston. Applications made to demand, supply, and consumption functions for agricultural products.

511 Econometrics II. Fall term. Credit four hours. Prerequisite: 510 or equivalent. Statistics and Biometry 417 suggested. Lecture, M 2:30–5. Warren 160. Mr. Mount.
An extension of multiple regression analysis to include generalized least squares, analysis of covariance models, and stochastic parameter models. Applications emphasize microeconomic problems using single equation techniques, for example, distributed lag models in investment theory. Additional topics include principal components, factor analysis, and probit analysis.

512 Quantitative Methods I. Fall term. Credit four hours. Course 417 or equivalent suggested though not required. M W F 11:15. Warren 160. Mr. Boisvert.
Linear programming with extensions, including postoptimality analysis, the transportation, and assignment models, risk programming, game theory, and input-output models. Applications made to problems in agricultural, resource, and regional economics.

513 Quantitative Methods II. Spring term. Credit three hours. Prerequisite: 512; an introduction to probability theory useful. M W F 10:10. Warren 261. Mr. How.
Probabilistic models and methods including queuing theory, inventory theory, Markov chains, dynamic programming, and simulation. Applications to a variety of problems in agricultural economics and business management are used to explore and evaluate the techniques.

Other

380H Independent Honors Research in Social Science. Throughout the year. Credit one to six hours. Open only to candidates who have met the requirements for the Honors program. A maximum of six credits may be earned in the Honors program.

499 Undergraduate Research. Fall and spring terms. Credit one to three hours depending upon the problem undertaken and the extent and quality of work done. A student desiring to register must attach to preregistration material, the written permission of the staff member who will supervise the work and assign the grade. Open to seniors with quality point averages of 2.7 or higher. Designed to afford opportunities for outstanding undergraduates to carry out independent studies of suitable problems under appropriate supervision.

507 Introduction to Research in Agricultural Economics. Fall term. Credit two hours. Open only to graduate students. W 1:25–3:20. Warren 361. Mr. Stanton.
A discussion of problems and methods used in doing research. Emphasis is placed on the organization of research projects, sources and methods of obtaining data, sampling, and the different methods of analyzing data commonly used by research workers in this field.

Agricultural Engineering

Students in the College of Agriculture and Life Sciences with a major interest in a semitechnical agricultural engineering program may elect a varied sequence of courses that will prepare them for opportunities with many of the industries, organizations, and agencies serving agriculture, or for farming enterprises which increasingly require understanding and application of engineering principles. A suggested sequence of courses may be obtained directly from the Department.

Students interested in a professional career in agricultural engineering for research, teaching, extension, design, product development, and manufacturing must take a prescribed sequence of courses that leads to a degree granted by the College of Engineering. The detailed curriculum may be found in the *Announcement of the College of Engineering.*

104 Energy Application in Agriculture. Fall term. Credit three hours. Limited to 25 students per laboratory section. Lectures, T Th 10:10. Riley-Robb 105. Recitation period, F 11:15 or 12:20. Riley-Robb 307. Laboratory, T W or Th 1:25–4. Riley-Robb 160. Mr. Black.
An introduction to technology in agricultural engineering, with primary emphasis on applications in the home. The basic principles of construction, water and waste water systems,

electrical wiring, lighting, electrical motors, heating, refrigeration, and ventilation will be covered.

106 Mechanical Drawing. Fall term. Credit three hours. Lectures, T Th 8. Riley-Robb 105. Laboratory limited to 40 students per section. Laboratory, W 1:25–4:25. Riley-Robb 425. Mr. Longhouse.
Graphic presentation, including lettering, use of instruments; orthographic projection of multiview drawings including sections, auxiliaries, plans and elevations; pictorial drawing, graphs and charts; elementary descriptive geometry; and the practical applications of these principles to simple problems. Both machine drawing and architectural drawing conventions and practices are discussed and employed in the solving of drawing problems.

107 Advanced Mechanical Drawing. Spring term. Credit three hours. Prerequisite: 106 or sufficient high school drawing. Lectures, W F 8. Laboratories limited to 40 students. Laboratory, Th 1:25–4:25. Riley-Robb 425. Mr. Longhouse.
A continuation of course 106 with work on machine drawing, including assembly drawings; intersections; developments; descriptive geometry; sectional and auxiliary views; and the use of conventional practices and symbols. Also studied are graphical methods related to other engineering courses and practical engineering problems; these include engineering graphs and charts; nomography; vector geometry and graphical calculus.
The student will be allowed to perform much of his drawing work with aid of drafting machines. Advanced drafting techniques are also discussed, illustrated, and employed as time permits.

152 Introduction to Agricultural Engineering Measurements. Spring term. Credit three hours. Prerequisite: one term of calculus or concurrent registration. Lecture, T 8. Laboratories, W F 1:25–4:25. Riley-Robb 160. Mr. Levine.
A study of the principles and methods of engineering measurements. Fundamentals of measurement, sources of errors, and measurement systems will be considered, including surveying measurements. Special attention will be given to methods for obtaining measurements that are required in a variety of agricultural engineering problems. An appropriate computing language will be taught and used in the solution of these problems.

153 Engineering Drawing. Fall term. Credit three hours. Open only to agricultural engineering technology and professional engineering students. Lectures, M W 8. Riley-Robb 425. Laboratory, M or T 1:25–4:25. Riley-Robb 425. Mr. Longhouse.
Designed to promote an understanding of the engineer's universal graphic language. The lectures will deal primarily with spatial relationships involving the problem-solving techniques of descriptive geometry. The laboratories will develop a working knowledge of drawing conventions, standard and advanced drafting techniques, and their application to machine, architectural, and pictorial drawing problems. Graphs and engineering graphics (nomography and graphical calculus) will also be included. Students will accomplish their work with drafting machines as well as the standard T-square and board. The first half hour of the laboratory will be utilized as in instruction-recitation period.

204 Farm Carpentry. Fall term. Credit two hours. Lectures, T 9:05. Riley-Robb 125. Laboratories limited to 15 students per section. Laboratory, T W or Th 1:25–4:25. Riley-Robb 70. Mr. Lechner.
Course includes instruction and skill practice in basic farm carpentry topics, including concrete work, woodworking, building construction, wood preserving and painting, and tool fitting. Each student is required to plan and construct a carpentry project. Indoor furniture projects are not acceptable.

205 Farm Metal Work. Fall or spring term. Credit two hours. Lecture, Th 9:05. Riley-Robb 125. Laboratories, 1:25–4:25. One laboratory section includes metal lathe work. This section is offered on Monday in the fall term and in the spring term; it is limited to 24 students. The other laboratory, which does not include metal lathe work, is limited to 20 students. It is offered on Tuesday in the fall term, and on either Tuesday or Thursday in the spring term.
Instruction and practice in fundamentals of electric arc welding, oxyacetylene welding, sheet metal work, pipe fitting, hot and cold metal work, and metal lathe work as they apply to farm shop work for both repair and construction jobs.

222 Farm Surveying. Spring term. Credit three hours. S-U grades optional. Lectures, T Th 11:15. Riley-Robb 105. Laboratory, M T or W 1:25–4:25. Riley-Robb 15. Laboratory limited to 16 students per section. Mr. Black.
An introduction to plane surveying. The use and care of surveying equipment is stressed, with particular reference to problems in agriculture.

233 Farmstead Production Systems. Fall term. Credit three hours. S-U grades optional. Lecture, M W F 8. Riley-Robb 105. Mr. Lorenzen.
A study of the facilities and equipment associated with agricultural production on the farmstead, with emphasis on buildings from the viewpoint of structural, environmental, operational, and bio-intrinsic design.

234 Farmstead Systems Laboratory. Fall term. Credit two hours. Limited to 15 students per section. Open only to students who are cur-

rently taking or have previously taken 233, Drawing 106, or Drawing 153. Laboratory, Th or F 1:25–4:25. Riley-Robb 307. (Friday section open only when numbers require.) Mr. Lorenzen.
Practice in planning of farmstead production facilities including structural design, insulation, ventilation, and materials handling. Studies of wood, concrete, and other structural materials.

305 Advanced Farm Metal Work. Fall or spring term. Credit one or two hours. Fall term, machine shop instruction; spring term, advanced welding and metal projects. Spring term prerequisite: 205, its equivalent, or permission of instructor. Laboratory, one credit, F 1:25–4; for two credits, one additional 2½ hour laboratory to be arranged. Riley-Robb 60 and 64. Mr. Lechner.

311 Farm Machinery. Spring term. Credit three hours. S-U grades optional. Not open to freshmen. Lecture, T Th 11:15. Riley-Robb 125. One recitation-laboratory each week, T W or Th 1:25–4:25. Riley-Robb 74. Limited to 15 students. Mr. Millier.
A study of the operating principles, use, selection, and methods of estimating costs of owning and operating farm machines. The laboratory work will include practice in the calibration of planting, fertilizing and pesticide application machinery, plus study of the functional characteristics of agricultural machines and machine components.

312 Farm Power. Fall term. Credit three hours. Prerequisite: 104 or Physics 102, or the equivalent. Lectures, T Th 11:15. Riley-Robb 225. Laboratory, M T or Th 1:25–4:25. Riley-Robb 74. Mr. Rehkugler.
A study of the use of power in agriculture, with emphasis on the principles of operation and adjustment of internal combustion engines and their use in farm tractors. Some of the topics covered are: power utilization in the U.S. and world agriculture, Nebraska Tractor Tests, tractor stability and traction, economics of power unit selection, and human factors in tractor design.

[313 Electricity on the Farm. Spring term. Credit three hours. Given in alternate years. Prerequisite: 104 or Physics 102 or the equivalent. Lectures, T Th 10:10. Riley-Robb 105. Laboratory, T or Th 1:25–4:25. Riley-Robb 164. Mr. Shepardson. Not given in 1972–73.
The application of electricity for light, heat, and power on farms, with emphasis on the principles of operation, selection, and installation of electrical equipment for the farmstead. Laboratory sections are combined for one half-day field trip.]

321 Soil and Water Conservation. Fall term. Credit two hours. S-U grades optional. Must be taken with Agronomy 321. Prerequisite: Agronomy 200 or equivalent; course 222 is recommended. Lecture, F 8. Riley-Robb 105. Laboratory, M or T 1:25–4:25. Riley-Robb 15. Mr. Levine.
A study of the principles and practices used in soil and water conservation. Engineering aspects of erosion control, water management and storage, drainage, and irrigation receive primary consideration.

401 Special Problems in Agricultural Engineering. Fall or spring term. Credit one or more hours. Normally reserved for seniors in upper two-fifths of class; undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Prerequisite: adequate ability and training for the work proposed. Staff.
Special work in any area of agricultural engineering on problems under investigation by the department or of special interest to the student, provided in the latter case, that adequate facilities can be obtained.

421 Introduction to Environmental Pollution. Spring term. Credit three hours. S-U grades optional. M W F 11:15. Riley-Robb 125. Mr. Ludington.
A general course dealing with impairment of the environment by the wastes of man. The cause and effects of air, water, and soil pollution will be discussed. Fundamental factors underlying waste production, abatement, treatment, and control will be included. A selected number of wastes from urban, rural, and industrial areas will be used to illustrate the factors.

450 Special Topics in Agricultural Engineering. Spring term. Credit one hour. S-U grades optional. Open only to seniors. T 12:20 Riley-Robb 225. Mr. Gunkel.
Presentation and discussion of the opportunities, qualifications, and responsibilities for positions of service in the various fields of agricultural engineering.

461 Agricultural Machinery Design. Spring term. Credit three hours. Given in alternate years. Prerequisite: mechanical design and analysis. Two lectures, one laboratory. Time and place to be arranged. Mr. Gunkel.
The principles of design and development of agricultural machines to meet functional requirements. Emphasis is given to computer-aided analysis and design, stress analysis, selection of construction materials, and testing procedures involved in agricultural machine development. Engineering creativity and agricultural machine systems are also stressed.

[462 Agricultural Power. Fall term. Credit three hours. Given in alternate years. Prerequisite: engineering mechanics (dynamics), or equivalent. Two lectures, one laboratory. Time and place to be arranged. Mr. Rehkugler. Not given in 1972–73.

Utilization of internal combustion engine energy and other forms of energy in agriculture. Basic theory, analysis, and testing of internal combustion engines for use in farm tractors and other agricultural power applications. Specific study of tractor transmissions, Nebraska Tractor Tests, and soil mechanics related to traction and vehicle mobility. Economics and human factors in power use and application will be considered.]

463 Processing and Handling Systems for Agricultural Materials. Spring term. Credit four hours. Given in alternate years. Three lectures, one laboratory. Time and place to be arranged. Mr. Furry.
Processes such as size reduction, separation, metering, and drying will be studied. Psychometrics, fluid flow measurement, and an introduction to dimensional analysis and controls for agricultural applications are included. Problem solutions will employ both the analog and digital computers. It is preferred that the student know how to write programs to utilize the digital computer prior to enrolling in the course.

[471 Soil and Water Engineering. Spring term. Credit three hours. Given in alternate years. Prerequisite: fluid mechanics and soils, or concurrent registration. Three lectures, one laboratory every other week. Time and place to be arranged. Mr. Black. Not given in 1972–73.
The application of engineering principles to the problems of soil and water control in agriculture. Includes design and construction of drainage systems and farm ponds, design and operation of sprinkler systems for irrigation.]

[481 Agricultural Structures and Environment. Spring term. Credit three hours. Given in alternate years. Prerequisite: structural engineering and thermodynamics. Lecture, T Th 11:15. Laboratory, W 1:25–4:25. Riley-Robb 307. Mr. Scott. Not given in 1972–73.
Synthesis of complete farmstead production units including structures, equipment, and management techniques. Integrated application of structural theory, thermodynamics, machine design, and methods engineering to satisfy biological and economic requirements.]

491 Highway Engineering. Credit three hours. S-U grades optional. Offered upon sufficient demand, usually in fall term. Prerequisite: consent of instructor. Principally directed study and individual or team investigations with one 2½ hour class session per week to be arranged. Mr. Spencer.
Emphasis is on secondary roads in study of: economic considerations in road improvement planning and programming; road location and geometric design; engineering soil characteristics and classification; design of roadbed thickness; drainage; stabilization methods and materials; dust palliatives; wearing surfaces.

501 Similitude Methodology. Spring term. Credit three hours. Two lectures, one laboratory. Time and place to be arranged. Mr. Furry.
Similitude methodology, including the use of dimensional analysis to develop general equations to define physical phenomena; model theory; distorted models; and analogies; with an introduction to a variety of applications in engineering. Problem solutions will employ both analog and digital computers. It is preferred that the student know how to write programs to utilize the digital computer prior to enrolling in the course.

502 Instrumentation. Spring term. Credit three hours. Prerequisite: consent of instructor. Two lectures, one laboratory. Time and place to be arranged. Mr. Scott and staff.
Emphasis is on the application of instrumentation concepts and systems to physical and biological measurements. Characteristics of instruments, application of operational amplifiers and transistors for signal conditioning and interfacing, shielding and grounding; transducers for measurement of force, pressure, displacement, velocity, acceleration, temperature, light, and flow; and data acquisition systems, including telemetry, are considered.

504 Biological Engineering Analysis. Fall term. Credit four hours. Prerequisite: consent of instructor, or Engineering 1151. M W F 9:05. Riley-Robb 225. Mr. Cooke.
Engineering problem-solving strategies and techniques will be explored. The student will solve several representative engineering problems which inherently involve biological properties. The mathematical modeling will emphasize problem formulation and interpretation of results. The student's knowledge of fundamental principles will be extensively utilized. Principles of feedback control theory will be applied to biological systems.

505 Solid Waste Management. Spring term. Credit three hours. Given in alternate years upon sufficient demand. Prerequisite: permission of instructor. M F 1:25–3. Room to be arranged. Mr. Loehr.
Study of municipal, industrial, and agricultural solid waste. Emphasis on waste characteristics, method of treatment and disposal, and interrelationship with air, water, and land environment. Discussion of economic and political aspects. Intended primarily for graduate student but open to qualified undergraduates.

506 Industrial Waste Management. Spring term. Credit three hours. Given upon sufficient demand. Prerequisite: permission of the instructor. Time and place to be arranged. Mr. Loehr.

Legal aspects, assimilatory capacity of receiving waters, waste sampling and analysis, treatment processes, waste reduction possibilities, waste quantity and quality, reuse and recovery, joint industry-municipal treatment of wastes, sewerage, service charges, case studies. Emphasis is on liquid industrial wastes. Intended primarily for graduate students but open to qualified undergraduates.

507 Treatment and Disposal of Agricultural Wastes. Spring term. Credit three hours. Prerequisite: permission of the instructor. Time and place to be arranged. Mr. Loehr.
Emphasis is on the causes of agricultural waste problems and on the fundamentals and application of possible treatment and disposal practices to control the problems. The course is aimed at having the students understand how to make decisions about selecting and utilizing appropriate agricultural waste management processes and systems, as well as how to design and operate the systems. Aerobic and anaerobic processes, nutrient control, waste utilization, and land disposal are included. The students will apply these and other concepts to the management of wastes from specific animal and crop production and food processing operations. Integration of feasible waste management methods into agricultural production constitutes a major part of the course.

551–552 Agricultural Engineering Project. Fall and spring term. Total credit six hours. Required for M. Eng. degree. Staff.
Comprehensive design projects utilizing real engineering problems. Emphasis on formulation of alternate design proposals, including economics and nontechnical factors, and complete design of the best alternative.

601 General Seminar. Fall and spring term. M 12:20. Riley-Robb 400. Fall term required of all graduate students majoring in the field. Spring term optional. Staff.

602 Power and Machinery Seminar. Spring term. Credit one hour. S-U grades only. Prerequisite: graduate status and permission of the instructor. Time and place to be arranged. Staff.
Study and discussions of research and new developments in agricultural power and machinery.

603 Soils and Water Engineering Seminar. Spring term. Credit one or two hours. S-U grades only. Prerequisite: graduate status and permission of instructor. Time and place to be arranged. Staff.
Study and discussion of research on selected topics in irrigation, drainage, erosion control, and agricultural hydrology.

604 Agricultural Structures and Related Systems Seminar. Spring term. Credit one hour. S-U grades only. Prerequisite: graduate status and permission of instructor. Time and place to be arranged. Staff.
Study and discussion of farmstead production problems, with emphasis on biological, economic, environmental, and structural requirements.

605 Agricultural Waste Management Seminar. Fall and spring terms. Credit one hour. S-U grades only. Prerequisite: graduate status and permission of instructor. F 3–4:30. Riley-Robb 105. Staff.
Study and discussion of the management of agricultural waste, with emphasis on the physical, chemical, biological, economic, and aesthetic requirements.

606 Biological Engineering Seminar. Spring term. Credit one hour. S-U grades only. Prerequisite: graduate status and permission of instructor. Time and place to be arranged. Mr. Scott and Mr. Cooke.
The interaction of engineering and biology will be examined, especially the environmental aspects of plant, animal, and human physiology in order to improve communications between engineers and biologists.

Agronomy

The Department of Agronomy offers instruction in both soils and field crops. It accepts as majors both students who are preparing for scientific professions and those who are interested primarily in applications of soil and crops subjects to practical problems. To accommodate all of these interests, the Department offers four areas of specialization: (1) crop science (2) soil science; (3) crops; and (4) soils (including soil conservation). In addition to College requirements, all of these specializations require a minimum of fifteen semester hours of agronomy, an elementary course in plant physiology, and demonstrated interest in the field. Agronomy majors are required to satisfy a ten-unit practice requirement. This can be accomplished by either farm practice or practice in the specialization.

Students preparing for graduate studies or scientific careers should choose the crop science or soil science specialization. Both require, in addition to the general requirements listed, a minimum of two semesters of calculus and fourteen semester hours chosen from among designated advanced courses in chemistry and physics. Emphasis is placed on the basic physical and biological sciences, and work in agronomy and related fields is selected to complement that training. The soil science curriculum satisfies requirements for professional certification by the Soil Science Society of America.

Students concerned primarily with applications of technical soil and crop subject matter to practical problems should spe-

cialize in soils or crops. Minimum departmental requirements are those common to all agronomy students. Curricula emphasize applied courses in agronomy and related fields, supported by those courses in basic physical and biological sciences essential for technical competence in the specialty.

Soil Science

200 Nature and Properties of Soils. Fall or spring term. Credit four hours. S-U grades optional. Prerequisite: Chemistry 103, 107, 115, or Biological Science 131. Lectures, M W F 9:05. Bradfield 101. Laboratory, fall term, M T W Th or F 2–4:25; spring term, M T W Th or F 2–4:25 or S 10:10–12:35. Bradfield 102. Fall term, Mr. Lathwell. Spring term, Mr. Scott.
A comprehensive introduction to the field of soil science with emphasis on scientific principles and their application in solutions of practical soil management problems.

301 Identification, Appraisal, and Geography of Soils. Spring term. Credit four hours. S-U grades optional. Prerequisite: course 200 or permission of the instructor. Lectures, M W F 11:15. Laboratory, M 2–4:25. Bradfield 105. Mr. Arnold.
The soil as a natural body. Principles of identification and classification of geographic units of soil and interpretation of such units for applied objectives. Geography of major kinds of soil of North America in relation to environment and cultural patterns. Field practice characterizing, mapping, and interpreting geographical soil units.

[306 Soil Microbiology (lectures). Spring term. Credit three hours. Given in alternate years. Prerequisite: 200 or Biological Science 290. M W F 8. Bradfield 108. Mr. Alexander. Not given in 1972–73.
A study of the major groups of soil microorganisms, their ecological interrelationships, and the biochemical functions of soil organisms.]

[307 Soil Microbiology (laboratory). Spring term. Credit one hour. Given in alternate years. Prerequisite: concurrent registration in 306. T 2–4:25. Bradfield 502. Mr. Alexander. Not given in 1972–73.
Laboratory exercises concerned with the ecology and biochemical activities of soil microorganisms.]

310 Agronomy Literature. Fall term. Credit one hour. S-U grades optional. Prerequisite: 200 and 111 or their equivalents. Beginning graduate students accepted by permission of the instructor. Th 12:20. Bradfield 105. Staff.
In addition to study of research and extension periodicals reporting work in agronomy, each student will review several scientific articles and prepare an essay on an appropriate subject in agronomy.

321 Soil and Water Conservation. Fall term. Credit two hours. S-U grades optional. Prerequisite: 200 or equivalent; course 111 is recommended. Must be taken with Agricultural Engineering 321. M W 8. Riley-Robb 15. Mr. Zwerman.
A study of the principles and practices used in soil and water conservation. Agronomic aspects of erosion control, water management and storage, drainage, and irrigation receive primary consideration.

324 Soil Fertility and Fertilizers. Fall term. Credit three hours. Prerequisite: 200 or permission of the instructor. M W F 9:05. Bradfield 108. Mr. Bouldin.
An integrated discussion of soil-plant relationships with emphasis on the soil as a medium for root growth, the soil as a source of mineral nutrients for plants, resources required for fertilizer production, and the role of fertilizers in crop production.

401 Geography and Appraisal of Soils of the Tropics. Spring term. Credit three hours. S-U grades optional. Lectures, W F 12:20. Discussion, F 2:30–4:25. Bradfield 105. Mr. Drosdoff.
Character, production potential, and management requirements of soils of tropical rain forests, tropical savannahs, tropical deserts, and tropical highlands, including soils under paddy culture. Emphasis is on soil properties associated with the principal kinds of soil and bases for their interpretation in terms of production potential and management requirements. Lectures are used to introduce principles whose applications are treated by problem solving, discussion, and independent study of the literature. Individuals who have not had the equivalent of course 200 will be expected to become familiar with elementary principles of soil on their own.

402 Chemical Methods of Soil Analysis. Spring term. Credit three hours. Prerequisite: 200 and Chemistry 236 or their equivalent. T Th 1:25–3:30. Bradfield 108. Mr. Peech.
Lectures and laboratory demonstrations designed to familiarize the student with different chemical techniques.

[403 Soil Organic Matter and Organic Soils. Fall term. Credit two hours. Given in alternate years. Prerequisite: course 200. T Th 9:05. Bradfield 105. Mr. Duxbury. Not given in 1972–73.
A study of the nature and properties of soil organic matter. Organic soils are treated as a special case of soil organic matter accumulation. Field trip to be arranged.]

404 Forest Soils. Fall term. Credit two hours. Given in alternate years. Prerequisite: 200. T Th 8. Bradfield 105. Mr. Stone.
Ecology of forest and wildland soils, including relationships to soil development, vegetation, and land use. Occasional field trips to be arranged.

[405 Soil Mineralogy. Fall term. Credit three hours. Given in alternate years. Prerequisite: 200 and one year each of college chemistry and physics or consent of instructor. Lecture, T Th 9:05. Laboratory, W 2–4:25. Emerson 334. Mr. Weaver. Not given in 1972–73.
A study of the minerals found in soils, with major emphasis on the structures, properties, and identification of the clay minerals. Topics will be related to the influence of clay minerals on physical and chemical properties of soils with special reference given to soils of the tropics.]

[406 Use of Soil Information and Maps as Resource Inventories. Fall term. Credit two hours. S-U grades optional. Given in alternate years. T Th 11:15. Bradfield 105. Mr. Olson. Not given in 1972–73.
Principles, practices, and research techniques in interpreting soil information and maps for planning, developing, and using areas of land.]

408 Soil Physics, Laboratory. Fall term. Credit two hours. Prerequisite: 200. Lecture, T 11:15. Laboratory, Th 1:25–4:25, or as arranged. Bradfield 502. Mr. Miller.
Experimental methods used in soil physics.

410 Microbial Ecology. Spring term. Credit two hours. Given in alternate years. Prerequisite: an elementary course in some facet of microbiology. M W 8. Bradfield 108. Mr. Alexander.
An introduction to the basic principles of microbial ecology. Attention is given to the behavior, activity, and interrelationships of bacteria, fungi, algae, and protozoa in natural ecosystems. (Also listed as Biological Sciences 492).

450 Special Topics in Soil Science. Fall and spring terms. Credit one to six hours. S-U grades optional. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. The topics to be treated will be arranged at the beginning of each term for individual self-study or for group discussions. Time to be arranged. Staff.

461 Regional Agronomy Studies. Fall term. Credit four hours. Enrollment limited and must be approved by instructor in charge during preregistration. Prerequisite: 111 and 200 or equivalent and permission of the instructor. Discussion, two hours per week, F 12:20–2:15. Bradfield 105. Three-week field-study trip during August 1972. Mr. Cline.
Study of soils, crops, agricultural institutions, and industries of Midwestern states and Northern Great Plains. The purpose is to give breadth of understanding of the field of agronomy in relation to allied fields. During the summer field-study trip, each student will be required to keep complete notes of basic subject matter for seminars, discussions, and assignments during the fall semester. Round-trip transportation will be provided from Ithaca. Students must finance meals and lodging, costs of which will be held to a minimum.

470 Undergraduate Research in Soil Science. Fall and spring terms. Credit to be arranged. Written permission from the staff member who will supervise the work and assign the grade must be attached to preregistered material. Time to be arranged. Staff.
Independent research on current problems selected from any phase of soil science.

480 Management Systems for Tropical Soils. Fall term. Credit three hours. Prerequisite: 200 or 401 or equivalent, or permission of the instructor. Lectures, W F 8. Discussion and problem solving, W 2:30–4:25. Bradfield 105. Staff on tropical soils.
Physical, chemical, and biological bases for adapting soil management systems for crop production to the needs of important kinds of tropical soils. Emphasis is on combinations of practices for managing soil fertility, water, and tilth for food-crop production. Soils of contrasting properties and environments will be studied.

[501 Soil Chemistry. Fall term. Credit three hours. Given in alternate years. Prerequisite: 200 and a one-year course in introductory physical chemistry, or consent of the instructor. T Th S 10:10. Bradfield 108. Mr. Peech. Not given in 1972–73.
Chemical composition and chemical properties of soils, with emphasis on ionic equilibria in soils.]

503 Morphology, Genesis, and Classification of Soils. Spring term. Credit three hours. Given alternate years. Prerequisite: graduate status or permission of the instructor. T Th S 10:10. Bradfield 105. Mr. Arnold.
Principles of soil classification, reactions and processes of soil genesis, and development and significance of major groups of soils of the world. One all-day field trip on a date to be arranged.

506 Advanced Soil Microbiology. Fall term. Credit one hour. S-U grades optional for graduate students only. Prerequisite: 306 or permission to register. T 12:20. Bradfield 105. Mr. Alexander.
Discussions of current topics in special areas of soil microbiology. Particular attention is given to biochemical problems in microbial ecology.

507 Soil Physics, Lectures. Fall term. Credit three hours. Given in alternate years. Prerequisite: 200 and one year of college physics or permission of the instructor. M W F 11:15. Emerson 334. Mr. Miller.

A study of physical properties and processes of soil, with emphasis on basic principles.

524 Soil Fertility, Advanced Course. Spring term. Credit three hours. Given in alternate years. Prerequisite: graduate status, major or minor in agronomy or permission of instructor. T Th S 9:05. Bradfield 105. Mr. Bouldin.
A study of selected topics in soil-plant fertilizer relationships with emphasis on concepts of soil fertility, interpretation of experimental data, and soil-fertilizer chemistry.

550 Research Orientation and Perspective. S-U grades optional.
See Agronomy—Crop Science.

560 Graduate Research in Soil Science. Fall and spring terms. By arrangement. Not open to undergraduates. All members of the graduate Field.

690 General Agronomy Seminar. Fall and spring terms. S-U grades only. Required of graduate students majoring or minoring in the department. Alternate weeks. T 4:30. Emerson 135.

691 Soil Science Seminar. Fall and spring terms. S-U grades only. Required of students whose major or minor subject is soil science. Alternate weeks with the general department seminar. Time to be arranged. Emerson 135.

Crop Science

111 Introduction to Crop Science. Fall or spring term. Credit four hours. Open to all classes beginning with first-semester freshmen. Lectures, M W F 10:10. Bradfield 101. Fall laboratory, M T W or Th 1:30–4:25; spring laboratory, T W Th or F 1:30–4:25. Emerson 338. Fall term, Mr. Seaney; spring term, Mr. Lucey.
Principles of field crop growth, development and maturation, species recognition, soil and climatic adaptations, liming and mineral nutrition, weed and pest control, cropping sequences, management systems, and crop improvement are considered. Feed crops for livestock and food and fiber crops including hay, silage, pasture, grain, protein and oil crops are emphasized. Field trips to observe and study experimental methods and procedures and/or farm operations are held during laboratory periods.

312 Feed Crops. Spring term. Credit four hours. Prerequisite: an introductory course in crop production. A course in livestock feeding in desirable but not essential preparation. M W F 8. Bradfield 101. Discussion, F 11:15 or 12:20. Emerson 334. Mr. Fick.
The production of field crops with reference to their value for livestock in terms of energy, protein, and other nutritional components. Consideration is given to establishment, management, harvesting, and preservation practices that influence yield and nutritive value. Forage grasses, forage legumes, and corn are emphasized.

315 Weed Science. Spring term. Credit three hours. Graduate students may register only by permission. Prerequisite: 111 and 200, Biological Sciences 103–104 or the equivalent. Prior or simultaneous courses in organic chemistry or plant physiology would be desirable. Lectures, T Th 8. Bradfield 108. Laboratory, M 2–4:25. Emerson 334. Mr. Duke.
Principles of weed science are examined. Emphasis is given to (*a*) weed ecology; (*b*) chemistry of herbicides in relation to effects on plant growth; and (*c*) control of weeds in all crops. Laboratory covers identification of weeds and physiology of herbicide action.

422 Tropical Agriculture. Spring term. Credit three hours. Prerequisite: a course covering elementary botany and permission of instructor. M W F 10:10. Bradfield 105. Mr. MacDonald.
Designed to provide some knowledge and understanding of the tropical environment and its agriculture. Topics covered include the agriculture, principal crops, cropping practices, and problems of the tropics and subtropics. Particular stress is given to (*a*) agricultural ecology; (*b*) agricultural patterns, traditions, and problems; (*c*) economic crops, their botany, adaptation, cultural requirement, improvement, management, protection production, and use, and (*d*) resources, limitations, and opportunities for tropical agricultural development and improvement. Independent study in special areas of interest is encouraged and facilitated. Lectures supplemented by illustrations, demonstrations, and discussions.

451 Special Topics in Crop Science. Fall and spring terms. Credit one to six hours. S-U grades optional. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. The topic to be treated will be arranged at the beginning of each term for individual self-study or for group discussions. Time to be arranged. Staff.

461 Regional Agronomy Studies.
See Agronomy—Soil Science.

471 Undergraduate Research in Crop Science. Fall and spring terms. Credit to be arranged. Written permission from the staff member who will supervise the work and assign the grade must be attached to preregistration material. Time to be arranged. Staff.
Independent research on current problems selected from any phase of crop science.

513 Crop Ecology. Fall term. Credit two hours. Given in alternate years. Prerequisite:

111, 200, and Biological Sciences 240. Class meetings to be twice weekly for last ten weeks of semester for two hours per meeting. Times to be arranged. Mr. Musgrave.
A study of special techniques used to obtain and analyze physiological data on crop plant responses to environmental conditions occurring in the field.

514 Grasslands and Grassland Research. Fall term. Credit three hours. Given in alternate years. Prerequisite: 111, 200, and Biological Sciences 240, or their equivalents, and permission of instructor to register. M W F 9:05. Bradfield 105. Mr. MacDonald.
A study of ecological factors underlying the development, maintenance, production, and management of different grassland types for various uses, and the principles and practices of grassland and forage crop investigations. Grassland species, types, and associations will be discussed in relation to adaptation, production, and use. Emphasis will be on research methods and techniques in the study of temperature, tropical and arid region, grasslands.

522 Special Studies in Tropical Agriculture. Spring term. Credit three hours. S-U grades optional. Prerequisite: 111 and 313 or equivalent and permission of instructor. Field laboratory trip to tropical area held during preceding January intersession but, because of limitation on participation, the field trip is not a prerequisite or a requirement of the course. Consult professor in charge regarding laboratory prior to November 1. Mr. MacDonald.
A study and discussion course designed for advanced students having special interest in tropical and world agriculture. Systems of agricultural production, ecological influences, and cultural practices of tropical and arid areas will be studied. Special attention will be given to tropical crops, their improvement, production, and management. The application of modern technology to tropical and arid region agriculture and the influence of change will be discussed. Independent study in areas or subjects of particular interest is encouraged and facilitated.

550 Research Orientation and Perspective. Fall term. Credit two hours. S-U grades optional. T Th 10:10. Emerson 334. Mr. MacDonald.
A course to familiarize students with the philosophy, organization, method, and conduct of research; and to provide information and practice in planning, organizing, writing, and oral presentation of results. The latter part of the course will deal with the reporting of research progress and results in relation to graduate study, seminar presentation, and thesis preparation. Active student participation is required.

561 Graduate Research in Crop Science. Fall, spring, and summer terms. By arrangement. Not open to undergraduates. All members of the graduate field.

690 General Agronomy Seminar. S-U grades only.
See Agronomy—Soil Science.

692 Crop Science Seminar. Fall and spring terms. S-U grades only. Required of students whose major or minor subject is crop science. Time to be arranged. Emerson 135.

Animal Science

A comprehensive program of courses is available to students interested in almost any phase of animal science. In consultation with an adviser, a student may select a sequence of courses that would prepare him for (1) livestock farming—dairy cattle, beef cattle, sheep, swine, horses, and laboratory animals; (2) positions in the feed and meat packing industries; (3) service in extension; (4) a variety of agricultural businesses; (5) entry into a veterinary college; or (6) graduate work. In the latter case, the usual program is modified to include the necessary physical and biological sciences that would permit following the more specialized fields of animal nutrition, animal physiology, animal breeding, animal genetics, or meat processing.

Students are generally advised to register for courses 100, 112, and 220 before electing the more advanced courses.

100 Introductory Animal Science. Fall term. Credit three hours. S-U grades optional. Lectures, W F 10:10. Morrison 146. Laboratory, T Th or F 2–4:25. Livestock Pavilion. Mr. Elliot.
Designed to acquaint the beginning student with the development, scope, economic importance, problems, and language of the livestock industry. All commercially important classes of farm animals are considered with emphasis on dairy cattle, beef cattle, sheep, and swine. The place of the biological sciences in a rapidly changing animal agriculture is stressed. The intent is to give insight into opportunities in the field and to serve as an introduction to subsequent specialized courses.

101 Livestock Management. Fall term. Credit three hours. For veterinary students only. Lectures, T Th 8. Morrison 163. Laboratory, T 10:10–12:35. Livestock Pavilion. Mr. Elliot.
Distribution, significance, problems, and practical management of commercially important classes of farm animals.

105 Contemporary Perspectives of Animal Science. Spring term. Credit one hour. Prerequisite: an interest in animal science. T

1:25, W 10:10, W 12:20. Morrison 348. Taught by the entire faculty of the Department of Animal Science.
A forum for students and faculty to discuss the contemporary and future role of animals in relation to the needs of man. Sections containing about 15 students will meet weekly with one faculty member. Informal discussion will be emphasized following short presentations by faculty and graduate students with special competence in the topic of the week.

241 Applied Livestock Selection and Meat Evaluation: Beef Cattle, Sheep, and Swine. Fall term. Credit two hours. Prerequisite: 100 or permission to register. Lecture and laboratory periods, W 2–4:25. Livestock Pavilion, Barns, and Morrison 82. Mr. Miller and Mr. Wellington.
Practical application of the various methods used in determining the utility value of market and breeding classes of meat animals and carcasses. Grading standards, meat quality and yield factors, breeding records, performance, and progeny tests are considered. A one-day field trip is taken to study market and consumer acceptability of meat products.

260 Beef Cattle. Spring term. Credit three hours. Prerequisite: 100 or permission to register. Lectures, T Th 10:10. Morrison 163. Laboratory, F 2–4:25. Livestock Pavilion and Beef Cattle Barns. Mr. Miller.
A general course in beef-cattle production. The management, feeding, breeding, selection, and marketing problems involved in the beef-cattle enterprise are emphasized. A one-day field trip is taken to study successful beef production methods.

265 Horses. Spring term. Credit two hours. Prerequisite: 100 or permission to register. Lecture, Th 9:05. Morrison 146. Laboratory, Th 1:25–4:25. Livestock Pavilion. Mr. Lowe and Mr. Hintz (in charge).
A course in selection, management, feeding, breeding, training, and marketing of light horses.

365 Seminar on Horse Production. Spring term. Credit two hours. Prerequisite: 112, 220, 221, and 265, or equivalent. Enrollment limited to 18 students. F 2–4:35. Morrison 163. Messrs. Lowe, Sabin, and Hintz (in charge).
Discussion of the management of various types of horse enterprises such as the breeding farm, training stable, and riding stable. One all-day field trip will be taken.

370 Swine. Fall term. Credit three hours. Prerequisite: 100, 112, 220 and 221 also recommended. Lectures, T Th 11:15. Morrison 163. Laboratory and discussion periods alternate M 1:25–4:25. Morrison 164 and Swine Barns. The laboratory and discussion period is given on alternate Mondays arranged so students can take 380 concurrently. Mr. Pond.
A general course in the characteristics of swine and their breeding, feeding, management, and selection. Laboratory and discussion periods are designed to give the student a practical knowledge of the pig as an animal and of commercial swine production practices.

380 Sheep. Fall term. Credit three hours. Prerequisite: 100; courses 112, 220, and 221 also recommended. Lectures, T Th 10:10. Morrison 163. Laboratory and discussion periods alternate M 1:25–4:25. Morrison 164 and Sheep Barns. The laboratory is given on alternate Mondays arranged so students can take 370 concurrently. Mr. Hogue.
A general course in the breeding, feeding, management, and selection of sheep. Lectures and laboratory are designed to give the student a practical knowledge of sheep production as well as the scientific background for improved practices.

400 Livestock Production in Warm Climates. Spring term. Credit three hours. Prerequisite: 112, 220, and 221 or permission of the instructor. Lectures and discussions, T Th 10:10–12:05. Morrison 342. Mr. McDowell.
Deals with factors inhibiting efficient livestock production and some of the potential roles animals can fulfill as sources of food, power, and fiber in the tropical areas of the world.

401 Special Studies on Problems of Livestock Production in the Tropics. Spring term. Credit three hours. Prerequisite: 400. Enrollment limited and must be approved by instructor. Preregistration required by December 1. Lecture and discussion time to be arranged. Mr. McDowell.
Eleven-day field trip to Puerto Rico during winter intersession for viewing problems in livestock and related agricultural production and research dealing with forage and phases of animal science. During the term in-depth studies will be made on some of the problems influencing livestock production in the tropics.

403 Forages of the Tropics for Livestock Production. Spring term. Credit three hours. Prerequisite: a course in crop production and in livestock nutrition and permission of the instructor. Lectures, M Th 12:20. Morrison 163. Discussion M 1:25. Morrison 342. Messrs. Crowder, MacDonald, McDowell (in charge), and Van Soest.
A review of the naturalized grasslands sown pastures and fodders of the tropics and their utilization for grazing and livestock feeding. Agronomic characteristics of grasses and legumes, pasture management, conduct of grazing trials, and systems of management for livestock will be considered. Nutritive value of tropical forages and digestibility studies are included.

Elementary Animal Physiology (Veterinary

310). Spring term. Credit three hours. Prerequisite: one year of biology or zoology and college courses in chemistry. M W F 10:10. Mr. Nangeroni.
Lectures and demonstrations arranged especially for students of agriculture but open to others; intended for students who do not plan to continue in physiology or allied fields.

Introductory Animal Physiology (Veterinary 312). Spring term. Credit three hours. Prerequisite: one year of biology and zoology, college courses in chemistry, and basic college mathematics. M W F 11:15. Mr. Craig and others.
The course deals especially with the identity and functions of the organ — systems of mammals, ruminant and nonruminant, with general comparisons to other forms. Particular emphasis is given to circulation, respiration, digestion, excretion, metabolism, and endocrine controls. The lectures, demonstrations, and exercises are intended to serve as a basis for subsequent work in the physiological sciences.

Health and Diseases of Animals (Veterinary 470). Spring term. Credit three hours. Not open to first-year students or to those who have had no course in animal husbandry. Lectures, M W F 11:15. Mr. Hall.
The causes and the nature of the common diseases of livestock are discussed. Emphasis is placed on the prevention and control of animal diseases.

Meats

290 Meat and Meat Products. Fall or spring term. Credit three hours. Lectures, T Th 9:05. Laboratory, fall term, M T or Th 1:25–4:25; spring term, M T or W 1:25–4:25. Morrison 82. Mr. Stouffer and Mr. Vadehra.
The course deals with the handling of red meat and poultry following slaughter. Composition, postmortem changes, and organoleptic changes of meat will be discussed. The course will also include packaging, preservation, development of new products, and merchandising of meat, poultry, eggs, and fish. Field trips to commercial plants will be taken.

490 Science and Technology of Meat, Fish, and Eggs. Spring term. Credit three hours. Prerequisite: 290 or permission. Lecture, T Th 11:15. Morrison 82. Laboratory, Th 1:25–4:25. Mr. Vadehra and Mr. Wellington.
The character of muscle as a food, muscle structure, meat product formulations and production, methods for meat-product quality control, product testing, and improved meat packaging. The basic principles of meat preservation, processing, and meat-product development through laboratory demonstration and practice in the pilot meat plant in Morrison Hall.

Dairy Husbandry

250 Dairy Cattle. Fall term. Credit three hours. S-U grades optional. Lecture, T Th 10:10. Laboratory, M 2–4:25. Morrison 342. Mr. Schmidt.
A general course in dairy cattle covering the trends in the industry, study of the breeds, factors in breeding and development of dairy cattle, milk secretion and milking methods, nutritive requirements of cows and feeding programs, calf raising systems, disease prevention, management, and record keeping systems.

251 Dairy Cattle Selection and Type Evaluation. Spring term. Credit three hours. Laboratory, W 2–4:25 throughout the term, S 10:10–12:35 during first half of term, and all day Saturday during last half of term. Livestock Pavilion. Mr. Trimberger.
A beginning course in the selection and type evaluation of all breeds of dairy cattle. Emphasis on herd improvement through high production and conformation characteristics for practical type to achieve wearability for high lifetime production. Educational lectures, demonstrations, and practice sessions include all-day trips to outstanding herds in the state.

350 Dairy Cattle Production and Management. Spring term. Credit three hours. Prerequisite: 112, 220, and 221. (Course 221 may be taken concurrently.) Lectures, T Th 11:15. Laboratory, T 1:25–4:25. Morrison 163. Messrs. Merrill (in charge), Schmidt, and Trimberger.
Designed for students who have an extensive interest in dairy cattle production and management. Analysis of dairy cattle breeding, housing, and management systems; development of feeding systems for economical production; and study of the principles of milk secretion and milking procedures, including evaluation of milking systems. Consideration will be given to the application of modern technology in these areas including farm visits to observe this technology in operation.

352 Advanced Dairy Cattle Selection. Fall term. Credit three hours. Prerequisite: 251. Registration by permission. Practice hours to be arranged. Mr. Trimberger.
Intended primarily to give additional training in comparative judging to successful students of 251. Members of the class are selected to represent the institution in intercollegiate judging competitions.

451 Physiology and Biochemistry of Lactation. Spring term. Credit three hours. Given if ten or more students register. Prerequisite: 427 or a course in physiology. Lecture, T Th 9:05. Morrison 163. Laboratory, Th 2–4:25. Morrison 174. Mr. Schmidt.
An advanced course in the anatomy of the mammary gland, the physiological mecha-

nisms of milk secretion, and biochemical synthesis of milk constituents in laboratory and farm animals.

455 Dairy Cattle Nutrition. Fall or spring term. Credit three hours. Prerequisite: a course in animal nutrition or permission of instructor. Given if eight or more students register. Given under the extramural program at regional locations to be arranged. Lectures and laboratory. Mr. Coppock and staff.
Designed to provide Cooperative Extension agents and vocational agricultural instructors with in-depth training which relates to the nutrition of the dairy cow. Areas of emphasis will include the anatomy and physiology of the digestive tract, biochemical relationships important in ruminant nutrition, metabolic diseases, and systems of feed analysis and feed formulation. The most recent research findings will be related to practical problems faced by Extension agents.

456 Dairy Cattle Physiology and Management. Fall or spring terms. Credit three hours. Prerequisite: a course in physiology or permission of instructor. Given if eight or more students register. Given under the extramural program at regional locations to be arranged. Lectures and laboratory. Mr. Natzke and staff.
Designed for in-depth training in physiology of lactation and reproduction, and dairy cattle management for Cooperative Extension agents and vocational agricultural instructors. Aspects of anatomy, physiology, and endocrinology will be discussed as they relate to milking, mastitis, housing, calf raising, and other management factors.

Animal Breeding and Physiology

220 Animal Reproduction and Development. Fall term. Credit three hours. Prerequisite: Biological Sciences 101 and 102 or 103 and 104. Limited to 40 students per laboratory section. Lectures, T Th 9:05. Morrison 146. Demonstration and laboratory, M T W Th or F 2–4:25, or T 10:10–12:35. Morrison 174. Mr. Foote.
An introduction to the comparative anatomy and physiology of reproduction of farm animals. The life cycle from fertilization of ova through development and growth of sexually mature individuals will be studied, with emphasis on physiological mechanisms involved, relevant genetic control, and the application to fertility regulation and improvement of animal populations. An audio-tutorial laboratory is available for independent study and to prepare for laboratory experiments.

221 Introductory Animal Genetics. Spring term. Credit three hours. Prerequisite: Biological Sciences 101 and 104. Lectures, T Th 12:20. Morrison 146. Laboratory, W Th or F 2–4:25 or Th 11:15–1:35. Morrison 342 and 348. Staff.
An introductory course in the breeding of large animals. Basic genetic principles, heritability of quantitative traits, estimation of breeding value, progeny testing, inbreeding, crossbreeding, lethal genes, genetic resistance to disease.

321 Seminar on Genetics of the Horse. Spring term. Credit one hour. Prerequisite: 265 or permission. Course 221 or Biological Sciences 281 recommended. Time and place to be arranged. Mr. Van Vleck and staff.
Discussion of genetics of the horse with special reference to inbreeding and selection for quantitative traits.

420 Quantitative Animal Genetics. Fall term. Credit three hours. Lecture, T Th 11:15. Laboratory, W or F 2–4:25. Morrison 342. Mr. Van Vleck.
A consideration of the problems involved in the improvement of animals, especially farm animals, through the application of the theory of quantitative genetics with emphasis on the selection index.

421 Seminar in Animal Genetics. Fall term. Credit one hour. Must be taken concurrently with 420. Time and place to be arranged. Mr. Van Vleck and staff.
Sections will be arranged depending on interests of students to discuss application of principles of quantitative genetics and animal breeding to specific types of animals, e.g., dairy, meat, and horses.

422 Research Techniques in Quantitative Animal Genetics. Fall term. Credit one hour. Prerequisite: 420 (may be taken concurrently). Time and place to be arranged. Mr. Van Vleck.
An introduction to methods of research in quantitative genetics and animal breeding including estimation of heritability, repeatability, and genetic and phenotypic correlations.

424 Animal Genetics. Fall term. Credit two hours. For veterinary students only. Lecture, M 8. Morrison 163. Laboratory, W 10:10–12:35. Morrison 164 and 174. Mr. Van Vleck.
Principles of genetics; sex determination and sex linkage; inheritance of characteristics in domestic animals, with special reference to lethal genes, genetic resistance to disease and quantitative characters; progeny testing, genetic relationships, and inbreeding.

427 Fundamentals of Endocrinology. Fall term. Credit four hours. Prerequisite: a course in human or veterinary physiology, or by permission. Lecture, T Th S 10:10. Morrison 167. Laboratory, T Th 2–4:25. Mr. Hansel.
A general course in the physiology of the endocrine glands and the roles played by each hormone in the regulation of normal body processes. The laboratory work consists of a series of experiments designed to illustrate the basic principles of endocrinology.

430 Livestock Improvement through Artificial Breeding. Spring term. Credit four hours. Prerequisite: 220, 221 or equivalent, and consent of instructor. Lecture, T 10:10. Recitation to be arranged. Laboratory, T and F 2–4:25. Morrison 174 and 167. Mr. R. W. Bratton.
The application of principles of physiology and genetics in the artificial breeding of farm livestock so as to maximize genetic improvement of those traits of economic importance. The laboratories will provide opportunity for students to obtain experience in the techniques relevant to both the male and the female aspects of artificial insemination of large farm animals, and to study the physiological, genetical, and economic problems relevant to the further improvement of livestock through the application of artificial insemination.

520 Experimental Methods in Quantitative Genetics and Animal Breeding. Fall term. Credit three hours. Prerequisite: Statistics and Biometry 417, and either Statistics and Biometry 513, or a course in mathematical statistics. Time and place to be arranged. Mr. Henderson.
Estimation of genetic and environmental parameters required to design efficient selection programs. Particular emphasis is given to interpretation of experimental and survey data with unequal subclass numbers and to prediction of genetic progress resulting from alternative selection methods.

610 Seminar in Animal Reproduction and Endocrinology. Spring term. Noncredit. Open to graduate students with majors or minors in animal physiology. T 4:30. Morrison 348.

620 Seminar in Animal Breeding. Fall or spring term. Credit one hour. Open to graduate students with major or minor in animal breeding. Time and place to be arranged.

Mammalian Physiology (Biological Sciences 414).

Animal Cytogenetics (Poultry Science 419).

Comparative Physiology of Reproduction of Vertebrates (Poultry Science 425).

Animal Nutrition

112 Livestock Nutrition. Spring term. Credit four hours. S-U grades optional. Prerequisite: Chemistry 103, 107, or Biological Sciences 131. Lecture, M W F 10:10. Morrison 146. Laboratory, M W Th or F 2–4:25. Morrison 164. Mr. S. E. Smith.
An introductory course in animal nutrition, covering fundamentals of nutrition, the composition of feeds, feeding standards, and their application to various forms of production in dairy and beef cattle, sheep, swine, and horses.

311 The Principles and Practice of Animal Feeding. Spring term. Credit three hours. Given primarily for students in the Veterinary College. Lectures, M W 8. Morrison 163. Laboratory, T 10:10–12:30. Morrison 164. Mr. Hogue.
Consideration is given to the basic principles of animal nutrition, nutritive requirements for various body functions; the identification, composition, and nutritive value of feeds; and the formulation of animal rations. The species covered include dairy cattle, beef cattle, sheep, swine, and horses, and there will be some consideration of dogs, cats, and other small animals.

410 Principles of Animal Nutrition, Lectures. Fall term. Credit three hours. Prerequisite: Organic chemistry. Biochemistry is recommended prior to or concurrently. M W F 10:10. Riley-Robb 125. Messrs. Hintz, Nesheim, (on leave), and Warner.
The principles of nutrition involving a discussion of proteins, fats, carbohydrates, and vitamins and minerals and their importance in animal nutrition.

411 Principles of Animal Nutrition, Laboratory. Fall term. Credit one hour. Enrollment limited to 12 students. Must be concurrently registered in 410. Registration by permission only. Time to be arranged. Mr. Nesheim (on leave) and Mr. Hintz.
Laboratory problems with animals will be designed to introduce the student to techniques of experimentation in nutrition.

Poultry Nutrition (Poultry Science 415).

511 Laboratory Work in Animal Nutrition. Fall term. Credit three hours. S-U grades optional. Prerequisite: quantitative analysis and 410, or its equivalent, or permission of the instructor. Laboratory, M W F 2–4:25. Morrison 342 and 443. Mr. Pond.
Each student engages in a series of short research projects with experimental animals, such as rats and sheep. Both classical and modern techniques of animal experimentation are considered. The applications of biochemical methods to the solution of animal nutrition problems are stressed.

619 Field of Nutrition Seminar. Fall and spring terms. Credit one hour. M 4:30. Fall, Morrison 348. Spring, Savage 100.
Current research in nutrition presented by visitors, graduate students, and faculty.

Advanced Nutrition

A series of nutrition courses are offered jointly by the Department of Human Nutrition and Food, College of Human Ecology; Department of Animal Science, College of Agriculture; Department of Poultry Science, College of Agriculture; and the Graduate School of Nutrition.

Prerequisites include courses in nutrition, physiology, and biochemistry to include in-

termediary metabolism, or permission of instructor.

Among the topics presented are the biochemical and physiological bases of digestion, absorption, transport and metabolism of nutrients, and species differences where applicable. Historical as well as current concepts of nutrition are discussed.

Proteins and Amino Acids (Human Nutrition and Food 501). Fall term. Credit two hours. M W 10:10. Martha Van Rensselaer 339. Miss M. A. Morrison.

Lipids and Carbohydrates (Poultry Science 502).

503 Nutritional Energetics. Spring term. Credit two hours. M W 10:10. Morrison 342. Mr. Reid.

Minerals and Vitamins (Poultry Science 504).

505 Biochemistry of Gastrointestinal Fermentation. Fall term. Credit two hours. S-U grades optional. Prerequisite: quantitative analysis, course 410, and Biochemistry 431, or permission of the instructor. Lectures to be arranged. Morrison 342 and 301. Mr. Van Soest.
Gastrointestinal fermentations in relation to utilization of cellulosic materials as food. Chemical composition of plants and factors affecting their nutritive value.

513 Forage Analysis. Fall or spring term. Credit two hours. Prerequisite: 505 and permission of the instructor. Enrollment limited to 5 students per term. Laboratory to be arranged. Mr. Van Soest.

Departmental Research and Seminars

395 Undergraduate Research. Fall and spring terms. Credit one to three hours, depending upon the problem undertaken and extent and quality of work done. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Open only to juniors and seniors of high scholastic ability with grade averages of 2.7 or above.
Designed to afford opportunities for outstanding undergraduates who plan to go to graduate school to carry out independent studies of suitable research problems under appropriate supervision. Each student will be expected to make a review of the literature, prepare a project outline, conduct the research, and write a summary report.

396 Undergraduate Teaching. Fall or spring term. Credit one or two hours, not to exceed a total of four. Prerequisite: 2.7 cumulative average and an interest in teaching. Written permission of supervising instructor required for registration. Time to be arranged. Staff.
Designed to enable qualified undergraduate students to consolidate knowledge by assisting in a course allied with the student's major training and experience. Each participating student is expected to meet regularly with a discussion or laboratory section; to gain teaching experience; to regularly discuss teaching objectives, techniques, and subject matter content with the professor in charge.

402 Undergraduate Seminar. Spring term. Credit one hour. S-U grades optional. Limited to advanced undergraduates interested in animal science. Hour to be arranged. Morrison 348. Staff.
A study of the pertinent literature of special topics in animal science. Students will be required to review current literature and to present oral and written reports.

500 Research. Fall and spring terms. Credit and hours by arrangement. All members of departmental staff.

601 Seminar. Fall and spring terms. Credit one hour. Required of all graduate students taking either a major or a minor subject in animal science. M 11:15. Morrison 348. Staff.

Biological Sciences

Students will be provisionally accepted in the Biological Sciences specialization as established by the Division of Biological Sciences during their freshman or sophomore years: application should be made to the Division of Biological Sciences Office. Prior to the senior year the student must have written approval of the Division of Biological Sciences of his admission to the major. Final admission to the specialization will require completion of:

(1) a year of biology (Biological Sciences 101–102 and 101L–102L; 101–102, if taken before 1971–72; advanced placement may be allowed at the student's choice, on receipt of a score of 5 in the Advanced Placement Test of the College Entrance Examination Board or a score of 3 or 4 and completion of Biological Sciences 105);
(2) a year of general chemistry (preferably Chemistry 107–108 or 115–116);
(3) a year of college mathematics including at least one semester of calculus (e.g. Mathematics 105–106, 111–112, 111–122, or 107–111).

Whenever possible, the student should include the above three subjects in his freshman schedule and complete organic chemistry and genetics in the sophomore year. A student is not encouraged to undertake a specialization in biological sciences unless his performance in the above courses gives evidence of capacity to do satisfactory work at a more advanced level.
In addition to the introductory courses in chemistry, biological sciences, and mathe-

matics, each specializing student must complete the following:

(1) Chemistry 353–355 (or 355 and 357–358, or 353–301, or 357–358–301);
(2) a year of physics (Physics 101–102 or 207–208);
(3) Biological Sciences 281 (Genetics);
(4) Biological Sciences 431 (Biochemistry);
(5) the breadth requirement outlined below;
(6) one of the concentration areas outlined below; and
(7) a minimum of six hours of college credit in a foreign language. It is recommended that the language requirement be met with French, German, Japanese, or Russian (other languages may be substituted only with special permission). Qualification in a foreign language, as defined by the College of Arts and Sciences, meets the Division's language requirement. *Students anticipating a concentration in biochemistry should contact an adviser in biochemistry as soon as possible.*

The breadth requirement is designed to ensure that each major student becomes familiar with a minimum number of different aspects of modern biology. In fulfillment of this requirement, each student must pass one of the listed courses in two of the following eight categories:

(1) *Neurobiology and Behavior:* Courses 320, 421, Psychology 201, 323
(2) *Development Biology:* courses 347A and B, 386
(3) *Ecology and Evolution:* courses 261, 301, 361, 475
(4) *Microbiology:* course 290A
(5) *Morphology:* courses 273, 313, 316, 345, Plant pathology 309
(6) *Physical Science and Mathematics:* courses Chemistry 389, Geology 101, Math 213 or 221, Physics 360, Statistics 407, 408 or 510, Computer Science 201, 202, 311
(7) *Physiology:* courses 242, 340, 410, 414 Vet. Med. 311, 312
(8) *Taxon-oriented courses:* 371, 344, 470, 471, 472, 474 Entomology 212

The concentration requirement is designed to help the student achieve depth in some area of biology of his own choosing. It permits maximum flexibility, while ensuring that the selection of advanced courses will form a coherent and meaningful unit. The student should seek the advice of his adviser in selecting the courses he will take in fulfillment of both the breadth and concentration requirements.

No more than four credit hours of research courses can be used for completion of the requirements in the area of concentration. The possible concentration areas are:

(1) *Animal Physiology and Anatomy:* Twelve hours, usually selected from Biological Sciences 273, 313, 316, 386, 410, 410A, 412, 414, 419 or 512; Animal Science 427–428; Poultry Science 425, 520; Veterinary Medicine 924.
(2) *Neurobiology and Behavior:* Biological Sciences 320, at least one semester of 620, and eleven hours, including a second course in neurobiology, to be selected in consultation with the adviser.
(3) *Biochemistry:* The student must fulfill the organic chemistry requirement by taking Chemistry 301, 302, 357, 358. In addition the student must take Chemistry 389 and 390, Biological Sciences 433 or 434.
(4) *Botany:* Biological Sciences 242 (or 340), 345, 347, and 371.
(5) *Ecology and Evolution:* At least 13 hours including courses 361 and 475; one course from the following three: 462 (not 462A), 463, 468; and a physiology course. At least four laboratory courses must be included, but students may count two courses taken for breadth requirement as laboratory requirement. Students planning graduate study are strongly urged to take a course in statistics (ILR 210 or 311).
(6) *Genetics and Development:* Nine hours usually selected from the following: courses 280, 347A, 347B, 386, 387, 440, 441, 475, 480, 484, 488, 495A, 495B; Statistics 510, Plant Breeding 505.
(7) *Microbiology:* Courses 290A and B plus three courses in microbiology of which at least one must be selected from among the following: 391B, 394, 490B, 495B, or Veterinary Medicine 341. This requirement may not itself satisfy the requirements for certification by the American Academy of Microbiology.

Students who, for good reason, wish to undertake a course of studies not covered by these seven concentration areas may petition for permission to do so.

Students interested in teaching biology in secondary schools may specialize in biological sciences for the Bachelor of Science degree and then complete the requirements for the Master of Arts in Teaching degree during a fifth year in the graduate Field of Education. The fifth year includes one semester of graduate study in the sciences, a summer of preparation for teaching, and one semester of internship in a secondary school. Stipends and fellowship support are available to selected candidates in the fifth year. Students interested in the five-year program leading to secondary school teaching are urged to consult their adviser and an adviser in the Department of Education during their freshman year. Courses appropriate to the student's program are described in the *Announcement of the Field of Education.*

The Honors Program offers a student an opportunity to do independent work under the supervision of a member of the faculty. This entails independent laboratory work on a project in addition to writing a thesis. Candi-

dates for this program must have at least a 3.0 cumulative average, although the committee will entertain petitions for special cases. He must also obtain a sponsor in a biology-oriented basic or applied science within the University. An Honors candidate will ordinarily enroll for credit in a research course under the direction of the faculty member acting as his Honors supervisor. No more than four credit hours of research courses can be used for completion of the requirements in the area of concentration. Recommendation to the faculty that a candidate graduate with Honors will be the responsibility of the Honors Program Committee. Students interested should consult their adviser for further details, preferably during the first term of the junior year.

Students interested in the Honors program must register with the office of the Division no later than the first term of the senior year. The final report of the student's work must be in the hands of the Committee not later than the first day of the study period to the week of the final examinations.

Many decisions pertaining to curriculum, to Division-wide requirements, and to depth and breadth areas, are made by the Curriculum Committee of the Division. The Committee has faculty and elected student members, and welcomes advice and suggestions from all interested parties. The Division office will supply information on Committee affairs.

General Courses

101–102 Biological Sciences. Throughout the year. Credit two hours a term. Must be taken concurrently with 101L and 102L. Biological Sciences 101 is prerequisite to 102, unless special permission is obtained from the instructor. 101–102 cannot be taken for credit after 107–108. Lectures, M W 9:05. Room to be arranged. Two preliminary examinations will be given each term at 7:30 p.m. Mrs. Feeny.

Designed both for students who intend to specialize in biological sciences and for those specializing in other subjects, such as the social sciences or humanities, who want to obtain a thorough knowledge of biology as part of their general education. Plant and animal materials are considered together rather than in separate units. The fall semester covers the origin of life, cellular biology, evolutionary patterns in the plant and animal kingdoms, the biochemistry of metabolism, physiology, and anatomy. The spring semester covers behavior, genetics, developmental biology, evolutionary theory, and the biology of populations and communities. Each topic is considered in the light of modern evolutionary theory.

101L–102L Biological Sciences, Laboratory. Throughout the year. Credit two hours a term. Must be taken concurrently with 101 and 102. One three-hour laboratory each week and a weekly lecture section for discussions, special lectures, etc. Lecture, F 9:05. Room to be arranged. Laboratory, M T W or Th 1:25–4:25, or T Th or F 10:10–1:00, or S 9:05–11:55, or M T or W 7:30–10:20 p.m. Mr. Ambrose, Mr. Zollinhofer, and assistants.

In the fall term, the general concepts of biology with particular emphasis on socially relevant topics will be covered. Optional areas of approach will be biological survey, environmental biology, and experimental biology. In the spring term students continue the laboratory approaches in 101L. In addition, laboratory sections may be offered that approach biology from several diverse viewpoints drawn from the following options: plant physiology, environmental physiology, molecular biology, morphology, zoology, neurobiology and behavior, population biology, and ecology.

105 Biological Discovery. Fall term. Two lectures and two laboratories weekly. T Th 9:05. Stimson G-1. Open to freshmen who achieve a grade of 3, 4, or 5 on either the biology advanced placement exam of the College Entrance Examination Board or an advanced placement exam administered during freshman orientation week. Also open to transfer students with one semester of college biology who attain a grade of 3, 4, or 5 on the freshman orientation-week advanced placement exam. Limited to 60 students. Not open to students who have credit for more than one semester of introductory biology or to students who have credit for 101–102 or 107–108. Passing 105 comprises fulfillment of introductory biology requirements in terms of (1) electing more advanced biology courses, and (2) fulfilling the biology distribution requirement for nonmajors. Students with advanced placement grades of 5 receive six credits for previous work in biology and are permitted to exempt all introductory courses including 105. If they take and pass 105, they receive an additional four credits. Students with advanced placement grades of 3 or 4 receive three credits for previous work in biology plus four credits for passing 105. Mr. Camhi.

The course is designed to instruct students in the ways that scientists ask questions about living things, and design and carry out observations or experiments to answer these questions. In the laboratory, students work in small groups on extended research problems which they help design. Instruction is highly individualized and aims at improving each student's ability to ask meaningful questions, organize and quantify his observations, analyze his research data, and relate his results to previously reported biological findings. Specific research techniques will be introduced when need arises.

Lectures, which expand the scope of the lab-

oratory experience, treat the conceptual and technical underpinnings of biological science, illustrating these with examples from diverse animal and plant disciplines. Biological content stresses properties and processes common to a wide range of living organisms, rather than focusing narrowly upon specific topics. It is hoped that this course will be useful to both potential scientists and to others wishing to attain a deeper insight into the nature of biological science.

106 Interactive Computing for Students of Biological Sciences. Spring term. Credit one hour. Lectures every other week, T 1:30. Stimson G125. Mr. Howland.

An introduction to computing using the interactive language FOCAL with a discussion of other algebraic computing languages such as BASIC and elementary FORTRAN. Students will be issued tickets for five hours of computing time at the Division of Biological Sciences interactive computing facility. Applications to problems in the biological sciences will be emphasized.

107–108 Biology for Nonmajors. Throughout the year. Credit three hours a term. Limited to 560 students. This course can be used to fulfill the Distribution requirement in the College of Arts and Sciences and the College of Agriculture and Life Sciences, but may not be used as an introductory course for the major in biological science. *Students who are uncertain of their choice of major should register in course 101–102. Note that course 107–108 may not always satisfy as a prerequisite to second and third level courses in biology.* Attendance in 107 is requisite for registration in 108, unless special consent is sought and obtained from the instructor. May not be taken for credit after 101–102. Lectures, M W F 9:05 or 11:15. Conferences M T W Th or F 2–4:15. Rooms to be arranged. Students do not preregister for the conferences; assignments will be made at the end of the first week of the semester. Each student must attend a conference on alternate weeks. Two preliminary examinations will be given each term at 7:30 in the evening; the dates are October 11 and November 17, 1972, and February 21 and April 2, 1973. No lectures will be given on these examination days. Mr. Blackler.

This course offers students who plan *not* to major in biological sciences the opportunity of taking a broad introductory course in modern biology, without the necessity of performing the detailed and formal laboratory study normally required. Nevertheless, the presentation is neither a course in social biology nor an attempt to popularize biology, but addresses itself to biological principles and phenomena with academic rigor. The content is designed to appeal to anyone who seeks a comprehensive knowledge of biology as part of his general education. Living things of all kinds are used as examples in a biological inventory which includes cellular life, life chemistry, heredity, evolution, and reproduction, as well as coverage of ecology, behavior, and the special case of man.

The conference sessions enable small groups of students to meet with the instructor and his assistants, and will be used for discussions and demonstrations.

201–202 Biology and Society. Fall and spring terms. Credit two hours per semester. S-U grades only. May not be repeated. Evening lectures, M 8. Room to be arranged. Discussion periods (one hour) to be arranged. Staff and invited speakers.

A series of public lectures dealing with a variety of topics concerning man as an individual, man as a member of society, and man as a member of the community of life on earth. The lectures are open to students and nonstudent members of the Cornell community as well as to other Ithaca-area residents.

Students enrolling for credit are requested to attend and participate in one of the weekly discussion groups. The purpose of the discussion period is to permit students to explore lecture material or related topics in depth.

Because the number of students who can be accommodated in Biology 201–202 is dependent upon an unpredictable and variable number of volunteer faculty members, from the many colleges and schools on the Cornell campus, preregistration in this course is not permitted. Registration will be accepted on the Tuesday and Wednesday following the first Monday lecture with preference given to upperclassmen.

203 Special Topics in Social Biology. Fall term. Credit three hours. S-U grades optional. Time to be arranged. Permission of the instructor is required. Students enrolled in this course are also expected to attend the Biology and Society lectures (course 201) without additional credit.

Normally, credit for course 203 will count for neither breadth nor concentration requirement in the Biological Sciences curriculum even if the section is under the direction of a biologist, although this restriction may be waived in isolated cases. Simultaneous enrollment in course 201 is not permitted. The purpose of this listing is to provide a vehicle by which any regular faculty member, visiting professor, or postdoctoral fellow with the rank of instructor at Cornell can present a one-semester course in which he discusses problems faced by modern society or guides students in the scholarly investigation of one of these problems.

This course may not be given each fall; information can be obtained by calling the Division of Biological Sciences (6-5233), or the Sci-

ence, Technology, and Society Program (6-3964).

204 Special Topics in Social Biology. Spring term. Credit three hours. S-U grades optional. Time to be arranged. Permission of the instructor is required. Students enrolled in this course are also expected to attend the Biology and Society lectures (course 202) without additional credit. In other respects this course is identical to course 203.

301 Laboratory Methods in Biology. Fall or spring term. Credit three hours. Limited to juniors, seniors, and graduate students; 20 students per section. Prerequisite: 101–102 or equivalent. Scheduled period T or F 10:10–12:35 consists of lecture and demonstration of work for the following week. Additional periods covered by leaving laboratory open at all times. The equivalent of at least one laboratory period per week required and sometimes several depending on the nature of the work. No formal examinations. Grade is based on required work, turned in at the end of the semester. Stimson 206. Mr. Uhler.
For students who intend to teach or follow some phase of biology as a profession. Subjects covered: collection, preservation, and storage of materials; the preparation of bird and mammal study skins; injection of circulatory systems with latex; clearing and staining of small vertebrates; and the preparation and staining of squashes, smears, whole mounts, and sections.

401 Teaching Biology. Spring term. Credit four hours. S-U grades optional. Enrollment limited. Prerequisite: permission to register. Hours to be arranged. Roberts 306. Mr. Zollinhofer.
Discussions of recent developments in the teaching of biology, and participation in teaching elementary biology at the college level.

405 Optics in Biology. Fall term. Credit two hours. Enrollment limited to 20. Prerequisite: Chemistry 104 or 108, Math 108 or 111, and Physics 102 or 208, or consent of the instructor. M 1:25–3:20. Plant Science 143. Mr. Clayton.
Lectures, problems, demonstrations, and laboratory experience in applications of optics to biology. Topics will include geometrical optics as applied to illumination systems, methods for studying biological effects of light, and analytical uses of optical absorption and fluorescence.

409 Research in Biology. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Staff.
Practice in planning, conducting, and reporting independent laboratory and/or library research programs.

503 Electron Microscopy for Biologists. Fall term. Credit three hours. S-U grades optional. Open to graduate students, with preference given to students who have thesis problems requiring electron microscopy. Permission of the instructor required. Preregistration recommended. Enrollment limited to 8. Lecture, T 11:15. Plant Science 141. Laboratory, T 1:25–4:25 or Th. 8–11. Bradfield B-07. Mr. Parthasarathy.
Course includes principles of electron microscopy, histological techniques for electron microscopy such as ultra-thin sectioning, negative staining and metal shadowing, and interpretation of results. A brief introduction to scanning electron microscope is also included.

504 Advanced Electron Microscopy for Biologists. Spring term. Credit three hours. S-U grades optional. Prerequisite: 503 and consent of instructor. Enrollment limited to 8. Lecture, T 11:15. Plant Science 141. Laboratory, T 1:25–4:25 or Th 8–11. Bradfield B-07. Mr. Parthasarathy.
Designed primarily for graduate students who have a major interest in ultrastructure. Selected topics in cell ultrastructure and interpretation, and introduction to special techniques such as freeze-etching, enzyme digestion techniques, and autoradiography are included. The student will also be required to do a project involving all or some of the specialized techniques.

Animal Physiology and Anatomy

210 Human Physiology. Spring term. Credit three hours. No credit for majors in biological sciences. Prerequisite: Chemistry 103 or equivalent; students must at least have taken high school courses in biology and chemistry. Lectures, M W F 8. Morrison 146. Mr. Stini and Mr. Thomas.
Basic concepts of human anatomy and physiology will be presented to provide the groundwork for the understanding of the functioning of the human body in health and disease. Emphasis will be placed on the relationship of human physiology to problems of public health and contemporary living. The individual systems, such as cardiovascular, gastrointestinal, neurological, endocrine, renal, etc., will be discussed singly and in correlation with each other. Guest lecturers will be invited as appropriate.

Introductory Physical Biology (Veterinary Medicine 311). Fall term. Credit three hours. Prerequisite: basic biology, chemistry, and calculus, or permission of the instructor. M W F 10:10. Mr. Comar and Mr. Wasserman.
A basic treatment of the application of physical principles to physiological problems. Coverage includes: mathematical approach to physiological problems; principles of tracers;

kinetics; systems analysis and control theory; physiochemical principles; flow of energy in living systems; flow of mass in living systems; contractility.

Introduction to Animal Physiology (Veterinary Medicine 312). Spring term. Credit three hours. Prerequisite: one year of biology and zoology, college courses in chemistry, and basic college mathematics. M W F 11:15. Mr. Craig and others.
The course deals especially with the identity and functions of the organ—systems of mammals, ruminant and nonruminant, with general comparisons to other forms. Particular emphasis is given to circulation, respiration, digestion, excretion, metabolism, and endocrine controls. The lectures, demonstrations, and exercises are intended to serve as a basis for subsequent work in the physiological sciences.

313 Histology: The Biology of the Tissues. Fall term. Credit four hours. Prerequisite: a two-semester introductory biology sequence; a background in vertebrate anatomy and organic chemistry or biochemistry desirable. Lectures, T Th 11:15. Stimson G-1. Laboratory, T Th 2–4:25. Fernow 14, 16. Mr. Wimsatt.
A general course dealing with the biology of the tissues to provide the student with a basis for understanding the microscopic and fine structural organization of vertebrates and the methods of analytic morphology at the cell and tissue levels. The dynamic interrelations of structure, composition, and function in cells and tissues are stressed.

316 Invertebrate Zoology. Spring term. Credit four hours. Prerequisite: at least one year of biological science or permission of instructor. Two lectures and two laboratories per week. Lectures, W F 11:15. Fernow 14. Laboratory, W F 2–4:25. Fernow 14. Mr. Anderson and assistant.
Lectures on selected topics in the development, structure, function, and interrelations of invertebrate animals, with particular attention to phylogenetic aspects. Intensive laboratory work on representative invertebrates, utilizing living or fresh specimens wherever possible. Each student will be expected to do a significant amount of independent work, and a term paper may be required.

410 General Animal Physiology: A Quantitative Approach, Lectures. Spring term. Credit three hours. S-U grades optional. Prerequisite: one year of biology and physics; courses in chemistry, organic chemistry, and biochemistry desirable. Lectures, M W F 10:10. Stimson G-25. Mr. Howland.
The principles of animal physiology are developed through consideration of the functioning of cells, tissues, and organs. Specific topics discussed include respiration, metabolism, circulation, excretion, body mechanics, muscle contraction, nerve action, sensory reception, and central nervous system function. A quantitative, systems-theoretical approach is emphasized.

410A General Animal Physiology Laboratory. Spring term. Credit two hours. Prerequisite: 410 or equivalent must be taken concurrently. Lecture, W 2. Stimson G-25. Laboratory, T 8–11 or M T Th or F 1:25–4:25. Stimson 306. Mr. Howland.
Students are introduced to basic techniques utilized in the study of the physiology of animal tissues. Experiments cover topics dealing with respiration, properties of muscle, circulation, activity of nerves, and osmotic phenomena.

412 Special Histology: The Biology of the Organs. Spring term. Credit four hours. Given in alternate years. Enrollment limited to 18 students. Prerequisite: 313 or consent of instructor. Lectures, W F 9:05. Fernow 14. Laboratory, W F 2–4:25. Fernow 14. Mr. Wimsatt.
A continuation of course 313. The microscopic and ultrastructural organization of the principal vertebrate organ systems are studied in relation to their development, functional interaction, and special physiological roles. Courses 313 and 412 together present the fundamental aspects of the microscopic and submicroscopic organization of the vertebrate body from a physiological perspective. The organization of the course involves student participation in lecture-seminars, and the prosecution of independent project work supplementary to the regular work of the laboratory. The latter enables students to gain practical experience with histological and histochemical preparative techniques.

414 Mammalian Physiology. Spring term. Credit six hours. Registration by permission. Prerequisite: a year of biological sciences. Courses in biochemistry, histology, and gross anatomy desirable. Lectures, M W F 8. Morrison 167. Discussion, S 10:10. Morrison 167. Laboratory, M or W 1:25. Morrison 174. Messrs. Bensadoun, Gasteiger, Hansel, and Visek (in charge).
A general course in mammalian physiology including circulation, respiration, digestion, metabolism, renal function, endocrinology, and the nervous system.

419 Research in Animal Physiology and Anatomy. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grades. Staff.
Practice in planning, conducting, and reporting independent laboratory and/or library research programs.

512 Comparative Physiology. Spring term. Credit two hours. Prerequisite: 410 or 414 and biochemistry or the equivalent. Students are encouraged to enroll in 512A concurrently. T Th 9:05. Stimson 318. Mr. McFarland and Mr. Pough.
A comparison of the principal physiological functions of vertebrates and invertebrates, with emphasis on adaption to different environments.

512A Comparative Physiology Laboratory. Spring term. Credit two hours. Limited to 10 students. Prerequisite: concurrent enrollment in 512 and consent of instructors. T Th 1:25–4:25. Stimson 318. Includes independent study. Mr. McFarland and Mr. Pough.
Introduction to comparative physiological techniques and their application to original research projects.

Animal Embryology (Biological Sciences 386).

Comparative Physiology of Reproduction of Vertebrates (Poultry Science 425).

Developmental Anatomy and Histology (Veterinary Anatomy 507).

Elements of Physical Biology (Veterinary Medicine 920).

Fundamentals of Endocrinology (Animal Science 427–428).

General Photobiology (Biological Sciences 547).

Neuroanatomy (Veterinary Anatomy 505).

Optics in Biology (Biological Sciences 405).

Insect Morphology and Histology (Entomology 322).

Sensory Function (Biological Sciences 427, 428).

Vertebrate Morphology (Veterinary Medicine 900).

Vision (Biological Sciences 425).

Neurobiology and Behavior

[320 Neurobiology and Behavior. Spring term. Credit three hours. Limited to juniors, seniors, and graduate students. Prerequisite: 101–102. Lectures, T Th S 12:20. Ives 120. Messrs. Eisner (in charge), O'Brien, van Tienhoven, Emlen, and Halpern. Not offered in 1972–73. Beginning 1973, fall term only.
Evolution of behavior, cueing of behavior; social and nonsocial behavior, neuroanatomy, neurophysiology, neurochemistry, neural networks, memory.]

323 Physiological Psychology. Fall term. Credit three hours. Prerequisite: Biological Sciences 101–102 or equivalent and introductory chemistry. Psychology 201 or a 300-level course in psychology. Lectures T Th 9:05. Upson 330. Mr. Halpern.
Selective examination of neural, endocrine, and biochemical functions related to emotion, memory, learning, perception, hunger, and thirst.

323A Physiological Psychology Laboratory. Fall term. Credit three hours. Prerequisite: 320, Psychology 201, concurrent registration in 323, and consent of instructor. Discussion, M 7:30–9 p.m. Laboratory, T 1:25–5. Stimson 216. Associate Mr. Halpern.
Experiments will be done on physiological aspects of conditioning in vertebrates and invertebrates, memory, interactions between hormones and behavior, and effects of brain lesions on perceptual and alimentary behavior. A final original experiment will be planned and carried out.

324 Animal Social Behavior. Spring term. Credit four hours. Limited to 20 undergraduates. Prerequisite: 101–102 or 103–104. Not open to students who have already taken 523. M F 11:15–1:10.

325 Fine Structure of the Nervous System. Fall term. Credit three hours. Prerequisite: 101–102 and 320; the latter may be waived by permission of the instructor. Lectures, T Th 11:15. Bradfield 108. Mr. Salpeter.
A course on the cellular organization of the nervous system. Special emphasis on development, functional relationships, and ultrastructure.

326 Elementary Neurophysiology. Spring term. Credit three hours. Prerequisite: 325 or permission of the instructor. Lectures, T Th 9:05. Room and discussion section to be arranged. Mr. Podleski.
Lectures will examine in detail the biophysical and biochemical properties of the excitable membranes of nerve cells and muscle. Emphasis willl be placed on the quantitative analysis and the possible molecular mechanisms underlying these properties. Topics to be studied include the origin of bioelectric potentials, excitability, synaptic transmission, neural circuits, the specificity of neural membranes, and possible mechanisms for plasticity.

328 Behavioral Maturation. Fall term. Credit three hours. Prerequisite: familiarity with psychological theories of learning and development and one year of college biology. W F 12:20. Goldwin Smith D. Mr. Lenneberg. Emergence of behavior will be studied in the light of developmental biology, including behavior genetics, neuroembryology and morphogenesis, physical maturation of the brain, transformation and allometry as well as retarding influences from the environment.

421 Comparative Vertebrate Ethology. Fall term. Credit three hours. S-U grades optional. Prerequisite: 101–102 or 103–104, and 320, and permission of the instructor. Lectures,

T Th 9:05. Rice 300. Laboratory, to be arranged. Mr. Dilger.
A survey of the methods and principles of vertebrate ethology for students specializing in this field or for those in other branches of zoology wishing to broaden their knowledge of animal behavior. Emphasis is placed on the causation, function, biological significance, and evolution-of-species typical behavior. The laboratories are designed to give first-hand knowledge of the material covered in lectures.

423 Animal Communication. Fall term. Credit four hours. Enrollment limited to 32 students. Prerequisite: Biological Sciences 320 and Physics 207–208. Lectures, T Th 10:10. Plant Science 143. Laboratory, T or Th 1:25–4:25. Mr. Capranica.
The course will emphasize the functional aspects of biological signals their physical properties, and the physiological mechanisms underlying their generation and reception. Lectures will examine in detail selected biological communication problems from each of the known sensory modalities. Discussion will cover signal analysis, transmission properties, and the limitation of each type of communication. Laboratories will include behavioral observations under both field and captive conditions, and individual experience with the techniques of signal recording and analysis.

424 Brain and Behavior. Fall term. Credit three hours. Prerequisite: familiarity with theories of perception, memory, and physiological psychology, or permission of the instructor. M 1:25–4. Morrill 340. Mr. Lenneberg.
A theoretical introduction to human neurology for psychologists. This survey of clinical symptoms and their etiology is designed to enable students to make use of disease for research purposes.

[425 Vision. Fall term. Credit two hours. Prerequisite: Chemistry 104 or 108, Math 108 or 111, Physics 102 and 208, or consent of the instructor; concurrent or previous enrollment in Biological Sciences 405 recommended. Lectures T Th 10:10. Plant Science 141. Mr. Clayton. Not given in 1972–73.
A study of the mechanism of seeing and embracing biological, physical, and chemical approaches to the subject.]

426 Neuropharmacology. Spring term. Credit three hours. Prerequisite: 431 and 320, or consent of instructor. Lectures M W F 8. Stocking 204. Mr. Eldefrawi.
The course deals with drugs that affect the nervous system, both central and peripheral. Emphasis will be on mechanisms of drug action whereby basic biochemical processes and neurophysiological and behavioral phenomena are bridged. Drugs discussed will range from cholinergic ones to depressants, stimulants, local anesthetics, and hallucinogens. Topics covered will also include drug addiction, use of drugs to uncover physiological mechanisms, and the biochemical basis of the therapeutic uses of drugs in diseases of the nervous system.

[427 Sensory Function (Lectures). Fall term. Credit three hours. Prerequisite: 320 or the equivalent. Lectures, M W F 11:15. Stimson 105. Discussion period to be arranged. Mr. Halpern and Mr. Tapper. Not given in 1972–73.
Sensory receptors and the central nervous system transformation of afferent activity will be considered in relation to human and animal psychophysical data and to the adaptive significance of behavior. The receptors will be examined in terms of anatomy, biochemistry, biophysics of transduction, and the central nervous system control of peripheral input. Information and signal detection theories will be applied.]

[427A Sensory Function (Laboratory). Fall term. Credit two hours. Enrollment limited to 15 students, and only by permission of the instructors. Prerequisite: 427. Hours to be arranged. Stimson 216. Organizational meeting 4:30 on the first Monday of the term. Mr. Halpern and Mr. Tapper. Not given 1972–73.]

428 Neurochemistry. Spring term. Credit three hours. Prerequisite: 431 and 326, 427 or 524, or their equivalent; 433 is also desirable. Enrollment approximately 50–100 students. Lecture-discussion T Th 11:15–12:45. Warren 131. Mr. Grossfeld.
Special features of the composition and metabolism of neural tissue will be discussed. The identification of synaptic transmitters In the nervous system, including their specific localization, biosynthesis and metabolism, release, inactivation, and action on postsynaptic receptors will be considered in detail. Chemical aspects of vision and of neuronal development and maturation will also be studied.

429 Research in Neurobiology and Behavior. Fall or spring term. Credit and hours to be arranged. S-U grades optional. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Staff.
Practice in planning, conducting, and reporting independent laboratory and/or library research programs.

[522 Brain Mechanisms and Models. Spring term. Credit four hours a term. Not offered in 1972–73.]

523 Ecological Aspects of Animal Behavior. Fall term. Credit four hours. S-U grades optional. Prerequisite: course work in animal behavior and ecology and permission of instructor. Enrollment will be limited. Lectures, T Th 11:15. Discussions, T Th 12:20. Warren

245. Mr. Emlen and Mr. Ambrose.
A discussion of the interrelationships of animal behavior and ecology, emphasizing adaptive strategies of social behavior. Topics include: behavioral adaptations to the environment; ecological significance of spatial organizations (territoriality, coloniality, nomadism); adaptiveness of diverse mating systems (monogamy, polygamy, promiscuity); optimization of foraging strategies; predator-prey interactions; role of social behavior in population limitation.

[524 Behavioral Neurophysiology. Spring term. Prerequisite: 320 or equivalent. One two-hour small discussion group weekly, time to be arranged. One lecture weekly, T Th or S 9:05. Warren 160. Enrollment limited to 25 students. Mr. Camhi. Not offered in 1972–73 or 1973–74.
Small group discussions of selected readings on a variety of related subjects; possible topics include (1) neuronal control of orientation behavior, (2) neuronal control of rhythmic behavior, (3) development of behavior and the nervous system, (4) sensory integration and behavior, (5) synaptic integration and behavior. Lectures will be presented as needed to aid in understanding material covered in groups. Opportunity provided for some students to lecture to the class.]

524A Behavioral Neurophysiological Laboratory. Spring term. Credit two hours. Enrollment limited to 15 students. Course 524 must be taken concurrently. Time and place to be announced. Mr. Camhi.
Experiments in neurophysiology, often related to specific behavior patterns.

525 Functional Organization of the Mammalian Nervous System. Fall term. Credit six hours. Given in alternate years. Prerequisite: two years of biological science. Courses in biochemistry, physics, and neural anatomy are desirable. Lectures, M W F 10:10. Laboratory, W 1:25. Mr. Gasteiger.
Cellular, sensory, central integrative, and motor aspects of the nervous system will be considered with an emphasis on the electrophysiological approach. Laboratory studies will include electrical activity of cells, reflexes, decerebrate ridigity, acoustic microphonic response, subcortical stimulation, and evoked and spontaneous cortical activity.

526 Bioelectric Systems. Spring term. Credit three hours. Prerequisite: 423 or 427 or 524, or Physics 360, or Electrical Engineering 4401, and permission of instructor. Lectures, M W 9:05. Discussion and demonstrations, Th 2. Phillips 320. Mr. Capranica and Mr. Kim.
This course deals with the application of systems techniques to biological problems. Electrical activity of nerve cells; generation and propagation of nerve impulse; voltage clamp technique, Hodgkin-Huxley model; electrical excitability and transfer function of neuromuscular systems; synaptic transmission; models of nerve cells and control system analysis of oscillatory activity. Nerve Nets: I. evoked activity; II. spontaneous activity; III. simulation and computer analysis. Functional neuroanatomy of brain; transfer characteristics of sensory receptors; sensory encoding and processing in the peripheral and central nervous systems; neural mechanisms for vision and hearing.

620 Seminar in Neurobiology and Behavior. Fall or spring term. Credit one hour. S-U grades optional. Time to be arranged. Organizational meeting, first Monday of semester, 8 p.m. Comstock 245. Staff.
Fall topic, animal behavior; spring topic, neurobiology.

622 Seminar in Ecological Animal Behavior. Spring term. Credit one hour. Open to qualified graduate and undergraduate students who have taken courses in animal behavior and ecology, and who have secured permission of the instructor. Time to be arranged. Enrollment limited to 12 students. Mr. Ambrose.

629 Advanced Topics in Neurobiology and Behavior. Fall or spring terms. A seminar course for graduate students and selected undergraduates. Topics, credit, and hours to be arranged. Staff and students.
The course is designed to provide several study groups each semester on specialized topics. A group may meet for whatever period is judged adequate to enable coverage of the selected topics. Ordinarily, topics will be selected and circulated during the preceding semester. Suggestions for topics should be submitted by faculty or students to the chairman of the Section of Neurobiology and Behavior.

Optics in Biology (Biological Sciences 405).

Biochemistry

130 Orientation Lectures in Biochemistry. Spring term. Noncredit. For freshman and sophomore students. Eight lectures or discussion sessions given in February and March covering interesting areas of biochemistry. W 7:30 p.m. Room to be arranged. Mr. Gaylor and staff.

131 Introductory General Biochemistry. Fall term. Credit six hours. A terminal course primarily for nonscience undergraduates. Lectures, M T W Th 11:15. Riley-Robb 105. Recitation, Th 2–4:25. Riley-Robb 15. Mr. Neal.
Lectures, demonstrations, and recitations dealing with selected fundamental principles of general, organic and biochemistry with emphasis on biochemistry.

231 Introductory Biochemistry. Fall term. Credit three hours. Prerequisite: Chemistry

104 or 108, or the equivalent. May not be taken for credit by students who have completed a more advanced course in this section. Lectures, T Th F 12:20. Stocking 204. Mr. Williams.
A brief survey of organic chemistry as related to biological compounds and a discussion of selected biochemical topics and reactions associated with the metabolism of animals, plants, and microorganisms. Especially designed as a general course for four-year students in agriculture.

431 Principles of Biochemistry (Lectures). Fall and spring terms. Credit four hours a term. Prerequisite: Organic Chemistry 353–355 or the equivalent. Fall term lectures, M T Th S 8. Ives 120. Miss Daniel. Spring term lectures, M W F S 10:10. Plant Science 233. Mr. Edelstein.
A basic course dealing with the chemistry of biological substances and their transformations in living organisms.

433 Principles of Biochemistry (Laboratory). Fall term. Credit three hours. Prerequisite: 431 (may be taken concurrently) and permission of the instructor. Laboratory, M W 2–4:25. Wing 106. Discussion period, M 1:25. Riley-Robb 105. Mr. Neal.
Laboratory practice with biochemical substances and experiments designed to illustrate basic biochemical principles and techniques. Designed primarily for students without biochemical laboratory training.

434 Principles of Biochemistry (Laboratory). Spring term. Credit four hours. Primarily for advanced undergraduates intending to enter graduate school and for graduate students. Prerequisite: 431 and permission of instructor. Laboratory, T W or Th 9:05–4:25. Wing 106. Lecture M 1:25. Riley-Robb 105. Mrs. Fessenden-Raden.
Laboratory practice with biochemical substances and experiments designed to introduce the student to techniques used in biochemical research, such as enzyme purification and characterization, kinetic analyses, use of radioisotopes, and chromatography.

435–436 Undergraduate Biochemistry Seminars. Fall and spring terms. Credit one hour each term. Juniors and seniors only. Enrollment limited. Prerequisite: 431 or consent of instructor. First meeting of each term is on the first Tuesday at 4 p.m. Fall term, Mr. Hinkle. Spring term, Mr. Williams.
A group of selected papers from the literature will be critically evaluated during six or seven two-hour meetings. A term paper will probably be required. Fall term: bioenergetics. Spring term: biochemistry and metabolism of amino acids.

439 Research in Biochemistry. Fall or spring term. Credit hours to be arranged. For undergraduate students concentrating in biochemistry. Prerequisite: adequate ability and training for the work proposed. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Mr. Gaylor and staff.
Special work in any branch of biochemistry on problems under investigation by the staff of the section.

[530 Biochemistry of the Vitamins. Spring term. Credit two hours. Given in alternate years. Prerequisite: Chemistry 353–355 and course 431 or their equivalent. Lecture, T Th 10:10. Savage 100. Miss Daniel. Not offered 1972–73.
The chemical and biochemical aspects of the vitamins.]

531–532 Intermediate Biochemistry (Lectures). Fall and spring terms. Credit four hours a term. Prerequisite: Chemistry 358, course 431 or consent of the instructor. Physical chemistry highly desirable. Lectures, M W F S 9:05. Riley-Robb 125. Fall term, Mr. Moffat. Spring term, Mr. Wilson and Mr. Hinkle.
The major areas of biochemistry will be covered in some detail. Appropriate for students who have previously had a one-semester introductory biochemistry course. Fall semester: proteins and the nature of enzymatic catalysis; carbohydrate metabolism; nitrogen metabolism. Spring semester: energetics; lipid metabolism; biosynthesis of informational macromolecules.

533 Intermediate Biochemistry (Laboratory). Fall term. Credit four hours. Prerequisite: Chemistry 287–288 or 389–390. Must be taken with or following 531. Laboratory, T or Th 9:05–4:25. Wing 106. One discussion period to be arranged. First meeting for both sections will be held on the first Tuesday at 9:05. Mr. Wharton.
Selected experiments on carbohydrates, proteins, amino acids, and metabolism (cellular particulates, kinetics, general enzymology) will be given to illustrate basic biochemical principles. The course will emphasize the quantitative aspects rather than qualitative identifications.

536 Advanced Biochemical Methods (Laboratory). Spring term. Credit two hours. Graduate majors in biochemistry only. Prerequisite: 533. Hours to be arranged. Mr. Wu.
After the formal instruction on research techniques in biochemistry and molecular biology, the students will do research work in the laboratory of three different professors chosen by the students.

631–632 Research Seminar in Biochemistry. Fall and spring terms. Credit one hour per term. S-U grades only. M 8–9:30 p.m. Wing 403. Mr. Hinkle.
Required of all graduate students (except

first-year students) majoring in biochemistry. The course may be repeated for credit.

633–638 Advanced Biochemistry. Throughout the year. Lectures and seminars on specialized topics, three topics per term. Credit one hour per topic. Prerequisite: 532 or consent of instructor. May be repeated for credit. The following fields will be covered. Each field is divided into three related topics: Enzyme Structure and Mechanism of Action (Fall 1972, 1974); Aspects of Protein and Nucleic Acid Synthesis (Spring 1973, 1975); Structure, Function, and Synthesis of Biological Membranes (Fall 1973, 1975); Aspects of Metabolic Pathways and Their Control (Spring 1974, 1976).

633 Aspects of Hemoglobin Structure and Function. Fall term 1972. First 4½ weeks of term. T Th 9:05. Savage 100. Mr. Gibson.

635 Topic to be announced. Fall term 1972. Middle 4½ weeks of term. T Th 9:05. Savage 100. Mr. Wu.

637 Control Mechanisms in Protein Biosynthesis. Fall term 1972. Last 4½ weeks of term. T Th 9:05. Savage 100. Mr. Wilson.

634 Molecular Regulation of Enzyme Activity. Spring term 1973. First 4½ weeks of term. T Th Savage 100. Mr. Hammes.

636 Regulation of Intermediary Metabolism. Spring term 1973. Middle 4½ weeks of term. T Th 9:05. Savage 100. Mr. Arion.

638 Nucleic Acids. Spring term 1973. Last 4½ weeks of term. T Th 9:05. Savage 100. Mr. Heppel.

639 Biochemistry Seminar. Fall and spring terms. Noncredit. F 4:15. Stocking 204. Staff.

The above course includes lectures on current research in biochemistry presented by distinguished visitors and staff.

Botany

242 Plant Physiology. Spring term. Credit five hours. Primarily for undergraduates in the agricultural sciences. Prerequisite: 101–102 and introductory chemistry. Lectures, T Th S 10:10. Plant Science 143. Conference, M T W or Th 12:20–1:10. Room to be arranged. Laboratory, M T W or Th 1:25–4:25. Plant Science 227. Conference and laboratory must be on same day. The laboratory is the same as for course 340. Mr. Davies and Mr. Spanswick.
Plant physiology as applied to plants growing in communities. Examples will deal with crop plants or higher plants where possible, though not exclusively. Topics will include cell structure and function; soil-plant-water relations; water uptake, transport and transpiration; irrigation of crops; sugar transport; mineral nutrition of crops; respiration and photosynthesis; light relations in crops; growth and development-hormones, flowering, fruiting, dormancy, and abscission; chemical control of plant growth.

340 Plant Physiology. Spring term. Credit three hours. Prerequisite: 101–102 and organic chemistry. Must be accompanied by 342 except by permission of the instructor. Lectures, T Th S 10:10. Plant Science 141. Mr. Jagendorf.
The behavior, growth, transport processes, and environmental response of plants. Topics will include membrane properties, solute and water transport, function of osmotic forces; mineral and organic nutrition; stress resistance; growth and hormonal action; metabolism including photosynthesis and respiration; responses to gravity, light, photoperiod, and temperature.

342 Plant Physiology Laboratory. Spring term. Credit two hours. Must be accompanied by 340. Conference and laboratory must be on the same day. Conference M T W or Th 12:20–1:10. Room to be arranged. Laboratory, M T W or Th 1:25–4:25. Plant Science 227. Mr. Jagendorf and Mr. Spanswick.

344 Phycology. Spring term. Credit four hours. Lectures, M W F 10:10. Plant Science 143. Laboratory, M or F 2–4:25. Plant Science 202. Mr. Kingsbury.
An introduction to freshwater and marine algae including consideration of their ecology as members of the plankton and benthos and their importance to man. The laboratory, utilizing field material and cultures from an extensive living collection, is designed to illustrate lecture topics, provide familiarity with algae in the field, and introduce the student to techniques used in isolating, culturing, and studying algae in the laboratory.

345 Plant Anatomy. Fall term. Credit four hours. Prerequisite: 101–102 and preregistration with instructor in charge. Lectures, T Th 8. Warren 145. Laboratory, T Th 10:10–12:35 or M W 2–4:25. Plant Science 211. Mr. Paolillo.

347 Cytology. Fall term. Credit four hours. Prerequisite: 101–102 or the equivalent; 281 recommended. Lectures, M W 9:05. Plant Science 143. Laboratory, M W or T Th 10–12:35. Plant Science 219. Mr. Uhl.
A study primarily of the structure of cells and their components and the relation of these to function and to heredity. Special attention is given to chromosomes. Both plant and animal materials are used.

347A Cytology, Lectures. Fall term. Credit two hours. Lecture part only of 347. Mr. Uhl.

347B Cytology, Laboratory. Fall term. Credit two hours. Prerequisite: 347A. Laboratory part of 347.

349 Plants and Man. Spring term. Credit three hours. S-U grades optional. Lectures and discussions, M W F 8. Warren 45. Mr. Bates.
A consideration of the role of plants in the human environment and in the evolution of civilizations. Intended for students in all colleges. Emphasis is on ethnobotanical considerations and on historical to present day utilization of plants in nutrition, housing, clothing, medicine, religion, and the arts.

440 Cytogenetics. Spring term. Credit three hours. Given in alternate years. Prerequisite: courses 347 and 281 or the equivalent. Lectures, M W 9:05. Plant Science 143. Laboratory, M or W 10:10–12:35. Plant Science 219. Mr. Uhl. Alternates with Poultry Science 419.
An advanced course dealing mainly with the cellular mechanisms of heredity and including recent researches in cytology, cytogenetics, and cytotaxonomy.

[441 Plant Growth and Development. Fall term. Credit three hours. Prerequisite: course 242 or 340 and 345, or equivalent, or permission of instructor. Lectures M W F 8. Bradfield 101. Mr. Davies and Mr. Paolillo. Given in alternate years. Not given in 1972–73.
An advanced course dealing with changes during growth and development of plants and their control: morphological and anatomical changes in apices; tissue differentiation; organ formation; embryo development; nucleic acid and protein synthesis: gene regulation; hormones—their action, mode of action, and interaction; the influence of light in development; flowering, fruiting, dormancy and abscission; reactions to stress.]

444 Comparative and Developmental Morphology of the Embryophyta. Spring term. Credit four hours. Given in alternate years. Prerequisite: 345 and consent of the instructor. Lectures, T Th 8. Plant Science 141. Laboratory, T Th 2–4:25. Plant Science 211. Mr. Paolillo.
The life histories of bryophytes, vascular cryptograms, and seed plants are explored for their developmental attributes and for their bearing on concepts of evolution and group relationships. The course content is presented so that an awareness of the integration between morphology and other disciplines in biology can be developed.

[448 Paleobotany. Spring term. Time and room to be arranged. Mr. Banks. Not given in 1972–73.]

449 Research in Botany. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Staff.
Students engaged in special problems or making special studies may register in this course. They must satisfy the instructor under whom the work is taken that their preparation warrants their choice of problem.

543 Plant Physiology, Advanced Laboratory Techniques. Fall term. Credit four hours. Primarily for graduate students doing work in plant physiology, but open to others if space permits. Prerequisite: organic chemistry, biochemistry, course 242 or 340, or the equivalent. Preregistration recommended. Laboratory, T or W 8–5. Plant Science 141. Recitation, M 4:30–5:30. Staff.
An introduction to some modern methods in experimental plant biology.

545 Photosynthesis. Fall term. Credit two hours. Prerequisite: Chemistry 104 or 108, Math 108 or 111, and Physics 102 or 208, or consent of the instructor. Concurrent or previous enrollment in 405 recommended. Lectures, T Th 10:10. Plant Science 141. Mr. Clayton.
A detailed study of the process by which plants use light in order to grow, emphasizing physical and physico-chemical aspects of the problem.

[547 General Photobiology. Fall term. Credit two hours. Open to undergraduate students. Prerequisite: same as for 545. Concurrent or previous enrollment in 405 recommended. Lectures, T Th 10:10. Plant Science 141. Mr. Clayton. Not given in 1972–73.
A study of the major interactions between light and living matter as encountered in photosynthesis, vision, regulation of physiology and development, bioluminescence, and damage by ultraviolet and visible light.]

[548 Plant Physiology: Aspects of Metabolism. Spring term. Credit three hours. Given in alternate years. Prerequisite: 242 or 340, and 431; Chemistry 353, or the equivalent. Lectures, M W F 9:05. Plant Science 141. Messrs. Jagendorf, McCarty, Thompson, and staff. Not given in 1972–73.
Selected areas of plant biochemistry will be reviewed in the context of the plant life cycle and responses to the environment. Probable topics include: metabolism and storage function of lipids, carbohydrates, organic acids, proteins and pigments; nitrogen and sulfur assimilation; hormone metabolism; respiration, photosynthesis, development and replication of mitochondria and chloroplasts; cell wall composition and properties. Attention will be paid to operation of control mechanisms.]

549 Plant Physiology: Transport of Solutes and Water. Fall term. Credit three hours. Given in alternate years. Prerequisite: 340 or equivalent. Lectures, M W F 10:10. Plant Science 143. Mr. Miller and Mr. Spanswick.
An advanced course dealing with the transport of ions, water, and organic materials in plants. Mechanisms of ion transport. Relation-

ships between ion transport and metabolism. Ion uptake and transport in higher plants. Phloem transport. Water relations of single cells and whole plants.

643 Plant Physiology Seminar. Fall and spring terms. Noncredit. Required of graduate students taking work in plant physiology. F 11:15. Plant Science seminar room. Staff.
Lectures on current research in plant physiology presented by visitors and staff.

645 Current Topics in Plant Physiology. Fall and spring terms. Credit two hours per term. Course may be repeated for credit. Time and place to be arranged. Staff.
Seminar reports by graduate students, on current literature in experimental plant physiology or related areas. Fall term 1972: Ion transport and electrophysiology. Spring term 1973: Mode of action of hormones. (Fall term 1973: Respiration and photorespiration.)

647 Special Topics in Plant Taxonomy. Fall and spring terms. Credit one hour per term. Prerequisite: permission to register. Lecture and discussion. Hours to be arranged. Mann Library 471. Messrs. Bates, Dress, Ingram, and Moore.
A series of four topics, one presented each term, designed to provide professional background in biosystematics, literature of taxonomic botany, nomenclature, and tropical families of phanerogams.
A. Fall term, not offered in 1972. Nomenclature. An analysis of the International Code of Botanical Nomenclature and its application to various plant groups. Lectures, problems, discussion. Mr. Dress.
B. Spring term, 1973. Biosystematics. A consideration of biosystematic approaches to taxonomy including chemical, numerical, cytological, and statistical methodologies as well as a review of classic studies. Mr. Bates.
C. Fall term, 1973. Families of Tropical Phanerogams. The families of flowering plants encountered solely or chiefly in tropical regions will be considered in lectures, discussions, and demonstrations with the aim of providing basic points of recognition for and an understanding of diversity and relationships in these families for the student venturing into the tropics. Mr. Moore.
D. Spring term, 1974. Literature of Taxonomic Botany. A survey of the basic reference works in taxonomy from the pre-Linnaean literature drawn on by Linnaeus to contemporary publications with comments on the peculiarities of the books (when appropriate) on publication dates, typographic devices, and intricacies of bibliographic citation. Lectures, demonstrations, discussions, and problems. Mr. Ingram.

Evolution, Taxonomy, and Ecology of Vascular Plants (Biological Sciences 371, 464, 663).

Plant Ecology (Biological Sciences 463).

Advanced Mycology (Plant Pathology 569, 579, 589).

Current Topics in Mycology (Plant Pathology 649).

Comparative Morphology of Fungi (Plant Pathology 309).

Optics in Biology (Biological Sciences 405).

Ecology, Evolution, and Systematics

261 Introductory Ecology. Fall term. Credit two hours. Prerequisite: one year of college biology or a score of 5 on the advanced placement examination. Lecture, T Th 11:15. Plant Science 233. Students concentrating in ecology and evolutionary biology must take 361 instead of this course. Mr. Brussard and Mr. Marks.
A course designed for students who want a basic grounding in the principles of ecology as a fundamental science. Topics covered will include the growth and limitation of populations, interactions between populations, the structure of communities, and the flow of energy and cycling of materials in ecosystems. The ecological effects of human overpopulation and its attendant problems will also be discussed.

273 The Vertebrates. Fall term. Credit five hours. Laboratory enrollment limited to 20 per section. Prerequisite: 101–102 or equivalent. Lectures, T Th 10:10. Stimson G-25. Laboratory, M W 1:25–5; T Th 1:25–5; M 7–10 p.m., F 1:25–5; T Th 7–10 p.m. Stimson 310, 316, 318. Mr. Pough and Mr. McFarland.
An introduction to the evolution, classification, comparative anatomy, life history, and behavior of vertebrate animals. Laboratory dissection, experimentation, and demonstration are concerned with structure, classification, systematics, biology of species, and studies of selected aspects of vertebrate life. Midterm examination will be given in the evening. Time to be announced.

361 General Ecology. Fall or spring term. Credit three hours. Not open to freshmen. Prerequisite: 101–102 or equivalent. Lectures, T Th 9:05. Plant Science 233. Discussion, W or Th 1:25, 2:30, or 3:35. Mr. Marks and Mr. Root.
Principles concerning the interactions between organisms and their environment. Influence of competition, social behavior, predation, and other factors of population size and dispersion. Role of energy flow and mineral cycling in determining the structure and productivity of ecosystems. Succession and classification of natural communities. Influence of climate and past events on the diversity and stability of communities in different regions of the world. Interspecific competition and the niche concept. Chemical interactions be-

tween organisms. Application of ecological principles to human problems. Modern evolutionary theory will be stressed throughout and attention given to conflicting ecological hypotheses.

364 Introduction to Marine Science. Summer. Credit four hours. S-U grades only. Prerequisite: a full year of college biology. A special course offered at the Cornell Marine Laboratory, Isles of Shoals, off Portsmouth, New Hampshire. The faculty includes approximately fifty lecturers from academic institutions, marine industry, governmental agencies, and fishermen. Professor Kingsbury (in charge).
Living material and habitats are emphasized in introducing students to the major disciplines of oceanography and in rounding out the student's knowledge of these topics as presented at inland locations. Shipboard demonstrations are conducted of oceanographic tools and techniques, and the North Atlantic fisheries are examined with the participation of commercial trawlers and fishermen from the Gloucester fleet and the National Marine Fisheries Service.
This course is presented cooperatively by Cornell University, the University of New Hampshire, and the State University of New York, and carries transcript credit at the participating universities. For more details see the *Announcement of the Summer Session,* or consult the Marine Biology Office, 202 Plant Science Building.

371 Taxonomy of Vascular Plants. Fall term. Credit four hours. Prerequisite: 281 or permission of the instructor. Lectures and discussions, T Th 9:05. Plant Science 143. Laboratory, T Th 2–4:25. Mann 464. Mr. Clausen.
An introduction to the evolution and classification of vascular plants, with attention to principles, methods of identification, and literature. In the first part of the term, trips are held in laboratory periods.

461 Oceanography. Fall term. Credit three hours. Prerequisite: 361 or consent of the instructor. Lectures, T Th 10:10. Stimson G-1. Additional lectures, Th 12:20 alternating with laboratory, M T or Th 2–4:30. Stimson 309. Mr. Barlow.
Physical and chemical aspects of the marine environment and interactions with marine communities. Laboratories devoted to demonstrations of field and laboratory techniques, experiments with simple models, and interpretation and analysis of typical oceanographic data.

[462 Limnology, Lectures. Spring term. Credit three hours. Prerequisite: 361, 261, or permission of instructor. Lecture, M W F 11:15. Stimson G-1. Mr. Likens. Not given in 1972–73.
A study of the interaction of biological communities and their aquatic environment. Lectures deal with the physical, chemical, and biological dynamics of freshwater ecosystems.]

[462A Limnology, Laboratory. Spring term. Credit two hours. Prerequisite: concurrent enrollment in 462. Laboratory, F 1:25–5:25 or S 8–12. Stimson 309. One all-day field trip. Mr. Likens. Not given in 1972–73.
Laboratories devoted to both field studies and experiments on model ecosystems.]

463 Plant Ecology. Fall term. Credit four hours. Prerequisite: two advanced-level courses in biology or consent of instructor. Lectures, M W F 11:15. Caldwell 100. Laboratory and field trips, T or F 2–5. Mr. Miller.
Principles of plant-environment interactions in relation to the distribution, structure, and functioning of plant communities. These principles will be illustrated by analysis in the field of representative plant communities and their environments, and by conducting experiments in the laboratory with plants grown under controlled environmental conditions.

464 Evolution and Ecology of Vascular Plants. Spring term. Credit four hours. Prerequisite: 371 or permission of the instructor. Lectures and discussions, T Th 9:05. Plant Science 143. Laboratory, T Th 2–4:25. Mann 464. Mr. Clausen.
A study of the variation, evolution, and ecological distribution of vascular plants. Laboratory periods in the later part of the term are devoted to study of natural populations in the field.

466 Chemical Ecology. Spring term. Credit two hours. Primarily for seniors and graduate students. S-U grades optional. Given in alternate years. Prerequisite: Chemistry 353 or 357–358, course 101–102 or permission of instructor. Lectures, M F 12:20. Comstock 245. Messrs. Alexander, Eisner, Feeny (in charge), Meinwald, and Whittaker.
Ecological and evolutionary significance of chemical interactions of organisms. Summary of key processes in regulation of natural populations. Survey of major classes of natural products with emphasis on appropriate analytical techniques. Chemical adaptations for reproduction, defense, habitat selection, dispersal, feeding efficiency and competition in animals, plants, and microorganisms. Choice of adaptive strategy in relation to energy flow. Practical applications of chemical ecology.

467 Species Distribution and Abundance. Fall term. Credit three hours. Prerequisite: 361; introductory statistics strongly recommended. Lecture, T Th 1:25–2:20. Laboratory, Th 2:35–4:30. Mr. Brussard.
An advanced course emphasizing the unifying principles of ecology, biogeography, and population biology. Topics include the distribution of organisms in time and space, bio-

geographic regions, continental and island patterns of distribution, ecology of dispersal and colonization, ecological and genetic considerations of population structure, and factors determining population size. Includes projects and exercises designed to give students firsthand contact with field techniques and data analysis.

468 Biology of Fishes. Spring term. Credit two hours. Prerequisite: introductory biology, or 273, or the equivalent. Lectures, M W 9:05. Rice 300.
An introduction to the study of fishes; their structure, classification, evolution, distribution, ecology, physiology, and behavior. Laboratory studies on structure, identification, classification, and nomenclature. Field studies of local species.

470 Icthyology. Spring term. Credit two hours. Prerequisite: 468 or consent of the instructor. Lectures, M W 9:05. Given in alternate years.
Lectures on advanced aspects of the biology of fishes including systematics, ecology, life history, and literature. Laboratory studies of the orders, major families, and principle genera, and of systematic procedures. Field studies of the ecology and life history of local species.

471 Mammalogy, Lectures. Spring term. Credit three hours. Prerequisite: 101–102; Lectures, T Th S 10:10. Stimson 105. Mr. Hudson and Mr. Richmond.
Lectures on the evolution, classification, distribution and adaptations, both physiological and morphological, of mammals.

471A Mammalogy, Laboratory. Spring term. Credit two hours. Prerequisite: concurrent enrollment in 471. Laboratory, T Th or W F 1:25–4:25. Stimson 316. Mr. Hudson and Mr. Richmond.
Laboratory and field work on ecology, behavior, physiology, and the taxonomy of recent mammals, with emphasis on the North American fauna.

472 Ornithology. Spring term. Credit four hours. Prerequisite: 273 or equivalent work in vertebrate biology and permission of instructor. Lectures, T Th 11:15. Bradfield 108. Laboratory, W 2–4:30 and S 8–11. Mr. Cade or Mr. Lancaster.
Lectures cover various aspects of the biology of birds, including anatomy, physiology, classification, evolution, migration and orientation, behavior, ecology, and distribution. Laboratory will include studies of external and internal morphology, pterylosis, molts and plumages, skin identification of birds of New York, and families of birds of the world. Several demonstration periods will emphasize hybridization, evolution, adaptive radiation, mimicry, and geographic variation. Field work includes identification of birds and familiarization of some techniques used in field research.

474 Herpetology. Spring term. Credit four hours. Prerequisite: 273 or equivalent experience in vertebrate zoology with permission of the instructor. Lectures, T Th 10:10. Bradfield 108. Laboratory, T Th 1:25–4:25 (plus irregular hours as required for experiments and some required evening and Saturday field trips). Stimson 316. Mr. Pough.
Lectures on the evolution, distribution, and adaptations of reptiles and amphibians. Emphasis on ecology, behavior, and physiology. Laboratory and field work on systematics, ecology, behavior, and physiology.

474A Herpetology Lectures. Spring term. Credit two hours. Graduate students only, permission of instructor required. Mr. Pough. The lecture portion of 474.

475 Organic Evolution. Fall term. Credit four hours. Prerequisite: 281 and a working knowledge of elementary algebra and logarithms. Also desirable is a course with some taxonomic content in botany or zoology, or experience in making and maintaining a collection of some plant or animal group. Lectures, T Th 11:15. Lecture or discussion, Th 12:20 and optional discussion one evening session each week, to be arranged. Comstock 245. Mr. W. L. Brown.
Lectures and class discussions on organic evolution, with primary emphasis on the mechanisms of animal speciation and adaptation. The course begins with a few lectures on taxonomic methodology.

479 Research in Ecology, Evolution, and Systematics. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to their preregistration material, written permission from the section chairman, and faculty who will supervise the work and assign the grade.
Practice in planning, conducting and reporting independent laboratory and/or library research programs.

561 Quantitative Ecology. Fall term. Credit four hours. Prerequisite: one year of biology and permission of instructor. Organic chemistry and some college mathematics are desirable. Lectures, T Th S 11:15. Laboratory, W 1:25–4:25. Stimson 225. Mr. Cole.
A quantitative course on selected ecological topics for advanced undergraduates and students. Topics include the origin and interpretation of habitat differences, toleration and response physiology, population dynamics, construction and uses of life tables, spatial distribution patterns, and approaches to the quantitative analysis of biotic communities.

562 Ecology of Pest Management. Spring term. Credit three hours. Prerequisite: 101–102 or equivalent. Lectures T Th 11:15. Special problem required. Comstock 145. Mr.

Pimentel and staff.
The focus will be on the ecology of pest management for the development of safe, effective population control measures. The "systems approach" to the management of pests (insects, algae, weeds, animal and plant pathogens, birds, and mammals) will be emphasized. Combinations of biological, physical, and chemical means for pest management will be discussed.

564 Advanced Plant Ecology. Spring term. Credit two or four hours. Prerequisite: 463. A course in plant physiology and a course in soils are strongly recommended. M W F 11:15. Plant Science 143. Mr. Whittaker and Mr. Miller.
Seminars dealing with either (*a*) physiological mechanisms and the physical, chemical, and biological processes which underlie the distributions of plants and communities, or (*b*) structure, function, and theoretic interpretation of plant communities. The seminars may be offered concurrently; both may be taken for four credits.

565 Special Topics in Limnology. Fall term. Credit one hour. Primarily for graduate students. Prerequisite: consent of instructor. Hours to be arranged. Mr. Likens.
Primarily a seminar course. Advanced discussion in specific topics which vary from year to year.

566 Marine Ecology. Spring term. Credit three hours. Given in alternate years. Enrollment limited. Prerequisite: 361, 461. Lectures, M W 9:05. Riley-Robb 15. Additional lecture, F 9:05 alternating with laboratory. Laboratory time to be arranged. Laboratory may also include independent study of special topics. Mr. Barlow.
Lectures will present a survey of current topics in biological oceanography, including biogeography, ecosystems, marine resources and environmental problems. Laboratory will consist of demonstration of common chemical and biological methods, with the last few weeks devoted to interpretation of typical oceanographic data.

566A Marine Ecology, Field Work. Spring term. Credit one hour. Prerequisite: concurrent enrollment in 566 and consent of instructor. Enrollment limited. Times to be arranged. Mr. Barlow.
An application of common sampling and observational techniques in biological oceanography. Students will be expected to become proficient in one or several techniques which will be employed on a one-week cruise on an oceanographic vessel to be scheduled sometime during the term. Remainder of the term will be devoted to completion of analyses and preparation of a report on the cruise.

[571 Special Topics in Higher Vertebrates. Fall term. Credit two hours. Enrollment limited. Prerequisite: advanced courses in vertebrate biology and permission of instructor. Hours to be arranged. Mr. Cade and Mr. Hudson. Not offered in 1972–73.
Seminars in selected topics of vertebrate ecology, behavior, physiology, and systematics with an emphasis on review of current literature.]

573 Special Topics in Lower Vertebrates. Fall term, even-numbered years only. Credit two hours. Enrollment limited. Prerequisite: consent of instructor. For advanced students in biological sciences. Hours and topics to be arranged. Mr. McFarland and Mr. Pough.
Seminars in selected topics in the biology of fishes, amphibians, and reptiles. Topics vary from year to year.

661 Seminar in Population and Community Ecology. Fall term. Credit one hour. Course restricted to graduate students. Prerequisite: permission of instructor. Lecture, M 7:30 p.m. Langmuir Penthouse. May be repeated for credit. Messrs Brussard, Levin, and Root.

663. Seminar in Evolution and Ecology of Vascular Plants. Fall term. Credit one hour. Prerequisite: 464 and Statistics 510 and 511 or equivalent, or permission of instructor. Lecture and discussion, M 11:15. Mann 464. Mr. Clausen.
A consideration of primary problems concerned with the classification, evolution, and environmental relationships of vascular plants.

[665 Environmental Physiology. Fall term. Credit three hours. Lectures, M W 9:05–10:35. Mr. McFarland and Mr. Miller. Not given in 1972–73.
Comparison of the responses and adaptations of organisms to environment in selected ecosystems. Emphasis on similarities and differences in molecular and organismal mechanisms by which plants and animals cope with their environments.]

[666 Population Ecology. Spring term. Credit three hours. Prerequisite: graduate standing with some background in calculus, statistics, ecology, and evolutionary theory plus consent of instructor. Lectures and discussions, M W 9:05–10:35. Mr. Cole and Mr. Brussard. Not given in 1972–73.
Critical examination of the properties and dynamics of populations. Emphasis on theories of population structure, dynamics, and regulation. Discussion of experimental approaches to analyses of natural populations.]

667 Community Ecology. Fall term. Credit three hours. Prerequisite: 666 or permission of instructor. Lectures, M W 9:05–10:35. Comstock 245. Messrs. Barlow, Marks, and Whittaker.
The structure and dynamics of natural communities; patterning and sampling problems, species-diversity, gradient relations, succes-

sion, and classification. Comparative aspects of terrestrial, marine, and freshwater communities will be stressed.

668 Ecosystems. Spring term. Credit three hours. Prerequisite: 667 or permission of instructor. Lectures, M W 9:05–10:35. Comstock 245. Mr. Whittaker and Mr. Likens.
Analysis of ecosystems in terms of energy flow, materials circulation, and model systems; biogeochemistry, pollution, and human ecology. Emphasis on the functional properties of ecosystems considered from simple systems to the biosphere as a whole.

669 Current Topics in Plant Ecology. Either term. Credit two hours. May be repeated for credit. Hours to be arranged. Mr. Miller.

Insect Biology (Entomology 212).

Invertebrate Zoology (Biological Sciences 316).

Advanced Soil Microbiology (Agronomy 506).

Soil Microbiology Lectures (Agronomy 306).

Soil Microbiology Laboratory (Agronomy 307).

Microbial Ecology (Biological Sciences 492).

Aquatic Plants (Agronomy 431).

Phycology (Biological Sciences 344).

Aquatic Entomology and Limnology (Entomology 471).

Introductory Insect Taxonomy (Entomology 331).

Advanced Insect Taxonomy (Entomology 531, 532, 533, 534).

Introductory Parasitology (Entomology 351).

Advanced Parasitology (Entomology 551).

Ecological Aspects of Animal Behavior (Biological Sciences 523).

Genetics and Development

280 Human Genetics. Spring term. Credit three hours. Prerequisite: 101–102 or equivalent. Students who have taken 281 may register only with permission of the instructor. Lectures, M W 10:10. Riley-Robb 125. Discussion, Th one section 10:10 or two sections 11:15 or F four sections 10:10 or one section 11:15. Limit of 25 each section. Room to be arranged. Mr. Srb.
An introduction to biological heredity through consideration of the genetics of man. Advances in the science of genetics are having a profound effect on man's understanding of himself and on his potential for influencing his present and future well-being. The course is intended primarily to contribute to the student's general education in these matters and, although certain aspects of genetics will be considered with some rigor, the course is not designed to serve as a prerequisite to advanced courses in genetics.

281A Genetics, Lectures. Fall or spring terms. Credit three hours. Prerequisite: 101–102 or 105 or equivalent. Students who have taken 280 may register only with permission of the instructor. Must be taken concurrently with 281B. Lectures, M W F 8. Plant Science 233. Preliminary examinations may be scheduled in the evening. Mr. Bruns (fall) and Mr. Fink (spring).
A general study of the fundamental principles of genetics in eucaryotes, procaryotes, and viruses. Discussions of gene transmission, gene action and interaction, gene linkage and recombination, gene structure, gene and chromosome mutations, genetic aspects of differentiation, genes in populations, breeding systems, extrachromosomal inheritance.

281B Genetics, Laboratory. Fall or spring terms. Credit two hours. Must be taken concurrently with 281A. Laboratory, M T W Th or F 2:30–4:25, T or Th 8–9:55, or S 10:10–12:05. Plant Science 41. Mr. MacIntyre and assistants.
A laboratory course in genetics emphasizing the principles of inheritance. Students perform experiments with microorganisms and conduct an independent study of inheritance in Drosophila. Students do not preregister for laboratory sections. Laboratory assignments will be made at the end of the first lecture period of 281A.

[386 Animal Embryology. Spring term. Credit four hours. Prerequisite: 281. Lectures W F 9:05. Stimson G-25. Laboratory, W and F 10:10–12:35 or 2–4:25. Fernow 14, 16. Mr. Wimsatt. Not given in 1972–73.
An introductory course in general animal embryology with major emphasis directed to vertebrates. The lectures cover the physiological, genetical, and morphological bases of early development. The laboratories have a strong anatomical theme.]

387 Molecular Aspects of Development. Fall term. Credit three hours. Prerequisite: 281; 431 highly recommended. Lectures, M W F 9:05. Stimson G-1. Mr. Hallberg.
Analysis at the cellular and subcellular level of the regulation of the synthesis and activity of gene products in the development of eucaryotes. Selected systems will be discussed which demonstrate the differential regulation of nucleic acid and protein synthesis within individual cells as well as between different populations of cells within a developing organism. Consideration will also be given to the development of cell organelle systems.

480 Population Genetics. Spring term. Credit three hours. S-U grades optional. Given in alternate years. Prerequisite: 281 or equivalent. Lectures, T Th 11:15. Plant Science 143. Mr. Wallace.

A study of factors which influence the genetic structure of Mendelian populations and which are involved in race formation and speciation. In contrast with 484, this course deals largely with the algebraic aspects of population genetics.

[484 Molecular Evolution. Spring term. Credit three hours. Given in alternate years. Prerequisite: 281 and organic chemistry. Lectures, T Th 11:15. Plant Science 143. Mr. MacIntyre. Not given in 1972–73.
An analysis of evolutionary changes in proteins and nucleic acids and gene-enzyme variability in natural populations. The role of natural selection in effecting these changes and maintaining genetic variation at the molecular level will be critically examined. Theories on the evolution of the genetic code and the construction of phylogenetic trees from biochemical data will be discussed.]

488 Genetics of Lower Eucaryotes. Spring term. Credit three hours. S-U grades optional. Prerequisite: 281 and a course in organic chemistry. Lectures, M W 9:05. Stocking 204. Messrs. Bruns, Fink, and Srb.
Genetic aspects of the biology of a few eucaryotic microorganisms, primarily yeast, Neurospora, and ciliated protozoa, with emphasis on the use of these organisms as experimental tools. Major topics to be covered include gene action, control mechanisms, cytoplasmic genetic systems, recombination and conversion, morphogenetic systems and evolutionary aspects of physiological systems. Extensive appropriate reading in the original literature of genetics is a primary component of the course.

489 Research in Genetics and Development. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Staff.
Practice in planning, conducting, and reporting independent laboratory and/or library research programs.

680 Current Topics in Genetics. Throughout the year. Credit two hours a term. Open to graduate students, with preference given to majors in the Field of Genetics; undergraduates by permission only. No auditors. Enrollment limited to 20 students. Time and place to be arranged. Staff.
A seminar course with critical presentation and discussion by students of original research papers in a particular area of current interest. Content of the course and staff direction will vary from term to term, and will be announced a semester in advance.

Animal Cytogenetics (Poultry Science 419).

Cytology (Biological Sciences 347A and 347B).

Cytogenetics (Biological Sciences 440).

Evolutionary Theory (Biological Sciences 475).

Microbial Genetics (Biological Sciences 495A and 495B).

Physiological Genetics of Crop Plants (Plant Breeding 505).

Plant Growth and Development (Biological Sciences 441).

Statistical Methods I (Statistics 510).

Microbiology

290A General Microbiology (Lectures). Fall or spring term. Credit three hours. Prerequisite: 101–102 or equivalent and Chemistry 104 or 108 or equivalent. It is recommended that 290B be taken concurrently. Lectures, M W F 11:15. Morrison 146. Fall term. Mr. H. W. Seeley; spring term, Mr. VanDemark.
A study of the basic principles and relationships in the field of microbiology, with fundamentals necessary to further work in the subject. The course offering in the spring term will provide special emphasis on the application of microbiology in home economics and agriculture.

290B General Microbiology (Laboratory). Fall or spring term. Credit two hours. M W 2–4:25; T Th 8–11 or 2–4:25. Stocking 301. Fall term, Mr. Seeley; spring term, Mr. VanDemark.
A study of the basic principles and techniques of laboratory practice of microbiology with fundamentals necessary to further work in the subject.

391A Natural Selection in the Bacteria. Fall term. Credit three hours. Prerequisite: 290 and 431 or consent of instructor; 431 may be taken concurrently. Lectures, M W F 9:05. Riley-Robb 105. Mr. MacDonald.
A study of the comparative physiological and ecological relationships among bacteria and some related organisms. A number of groups of bacteria will be discussed in detail as well as factors which influence their ability to survive in nature. Parasitism, autotrophy, and evolution will be among the major topics discussed.

391B Bacterial Ecology Laboratory. Fall term. Credit three hours. Enrollment limited to 15. Prerequisite: concurrent registration in 391A and consent of instructor. Laboratory, M W F 1:30–4. Mr. MacDonald.
Techniques for the isolation, cultivation, and detailed study of selected groups of organisms. Some of the more standard techniques of physiological study will be introduced. Emphasis will be placed on independent work.

393 Applied and Industrial Microbiology. Fall term. Credit three hours. Given in alternate years. Prerequisite: 290 or equivalent. Lectures, T Th S 11:15. Stocking 119. Messrs. Delwiche, Dondero, and VanDemark.

A survey of the microbiology of industrial fermentations, water, and waste decomposition.

394 Food Microbiology. Spring term. Credit four hours. Prerequisite: 290A, 290B. Graduate students must have permission of the instructor. Lectures, M W 12:20. Stocking 120. Laboratory, M W 2–4:25. Stocking 301. Mr. Naylor.
The major families of microorganisms of importance in foods are studied systematically with emphasis on the role played by these organisms in food preservation, food fermentations, and public health. The laboratory work includes practice in the use of general and special methods for microbiological testing and control of food products as well as practice in the isolation and characterization of organisms found in foods.

490A Microbial Physiology Lectures. Spring term. Credit three hours. Prerequisite: 391A or permission of instructor. Primarily for microbiology majors intending to enter graduate school and for graduate students. Lectures, T Th S 10:10. Stocking 119. Mrs. Gibson. A study of the organization of physiological processes in microorganisms, including a study of structure, energy-yielding mechanisms, macromolecular biosyntheses, and growth and regulation.

490B Microbial Physiology Laboratory. Spring term. Credit three hours. Enrollment is limited and preference will be given to students obtaining a grade of B— or better in 391B. Prerequisite: co-registration in 490A and permission of instructor. Laboratory, F 9:05–4:25. Stocking 321. One discussion period to be arranged. Mrs. Gibson.
Experiments on material covered in 490A will be used to introduce modern research techniques for the study of growth and physiological activities.

492 Microbial Ecology. Spring term. Credit two hours. Given in alternate years. Prerequisite: elementary course in some facet of microbiology. M W 8. Bradfield 105. Mr. Alexander.
An introduction to the basic principles of microbial ecology. Attention is given to behavior, activity, and interrelationships of bacteria, fungi, algae, and protozoa in natural ecosystems.

495A Microbial Genetics, Lectures. Fall term. Credit two hours. S-U grades optional. Prerequisite: 281 and 290A, or permission of the instructor. For upperclassmen and graduate students. Lecture, W 7:30–9:25 p.m. Stocking 204. Mr. Zahler.
Genetics of bacteria and their viruses, with emphasis on the mechanisms of genetic phenomena.

495B Microbial Genetics, Laboratory. Fall term. Credit three hours. Prerequisite: 495A (may be taken concurrently) and permission of the instructor. Primarily for upperclassmen. Laboratory, T 1:25–4:25, and four other hours to be arranged. Stocking 321. Mr. Zahler.
Problem solving in bacterial genetics.

496 Selected Topics in Microbial Metabolism. Spring term. Credit two hours. S-U grades optional. Prerequisite: beginning courses in general microbiology, biochemistry, and organic chemistry. Primarily for upperclassmen and graduate students. Lectures, M W 11:15. Riley-Robb 15. Mr. Delwiche.
Selected topics pertaining to the energy metabolism, oxidative and fermentative abilities, and biosynthetic capacities of microorganisms. Where possible and appropriate the subject matter deals with the various microbial forms in a comparative sense.

498 Virology. Spring term. Credit three hours. Given in alternate years. Prerequisite: 290A and 281 or permission of the instructor. Lectures, T Th S 11:15. Stocking 204. Mr. Naylor and others.
A study of the basic physical, chemical, and biological properties of plant, animal, and bacterial viruses.

499 Research in Microbiology. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. This course cannot be used to fulfill the concentration requirement. Staff.

590 Methods in Advanced Bacteriology. Fall and spring term. Credit to be arranged. Enrollment limited. Prerequisite: permission of instructor. Primarily for graduate students in microbiology. Hours to be arranged. Staff.
Intended to acquaint advanced students with some of the more important techniques used in microbiology.

596 Molecular Immunology. Spring term. Credit two hours. For advanced undergraduates and graduate students. Prerequisite: 531 or permission of the instructor. W 7:30–9:25 p.m. Stocking 204. Mr. Slobin.
A study of the immune response with particular emphasis on the structure and evolution of immunoglobulins, the nature of antigen-antibody interactions, and the molecular biology and antibody biosynthesis.

691 Graduate Seminar in Microbiology. Fall and spring terms. Credit one hour per term. Required of all graduate students majoring in microbiology. Time and place to be arranged. Staff.

699 Microbiology Seminar. Fall and spring terms. Noncredit. Required of graduate students majoring in microbiology and open to

all who are interested. Th 4:15. Riley-Robb 105. Staff.

[Soil Microbiology (Agronomy 306).]

Advanced Soil Microbiology (Agronomy 506).

Immunochemistry (Veterinary Medicine 944).

Animal Virology (Veterinary Medicine 945).

Microbial Ecology (Agronomy 410).

Basic Immunology Lecture (Veterinary Medicine 340).

Pathogenic Microbiology (Veterinary Medicine 341).

[Advanced Immunology Lecture (Veterinary Medicine 941).]

[Advanced Immunology Laboratory (Veterinary Medicine 942).]

Communication Arts

This curriculum is based on a strong foundation in the sciences and humanities, which provides content and breadth needed for a specialty area such as communication arts. Beginning with the sophomore year communication courses are carefully integrated with those in other disciplines to offer majors intellectual strengths for individual accomplishment. Prospective majors may get additional information directly from the Department. Each major must complete twenty-six semester hours of communication arts courses prior to graduation. Those specifically required are: 200, 301, 311, 401, 420 or 421, and 430. Majors must also select one of the following: 214 or 215; and two from the following: 313, 315, 316, 318, and 319.

Each major must be involved in campus communication activity each semester. The student should consult his adviser for details.

The Graduate Teaching and Research Center of the Department of Communication Arts is located at 640 Stewart Avenue.

Communication Theory

200 Theory of Human Communication. Fall term. Credit three hours. S-U grades optional. Lecture, T Th 10:10. Discussion, T or Th 12:20. Bradfield 101. Mr. Barwind.
Introduction to behavioral theories of communication from a multidisciplinary perspective. Contributions from the mass media, anthropology, sociology, psychology, social psychology, rhetoric, and cybernetics are considered.

403 Topics in Communication Theory. Fall term. Credit three hours. Prerequisite: 200 or consent of instructor. M W F 9:05. Warren 260. Mr. Miller.
Specific topics to be covered will vary from semester to semester but generally will be drawn from such areas as communication between polarity groups, roleplaying and communication, therapeutic communication, nonverbal communication, effects of status on communication patterns and networks, interpersonal influence and person perception, mass persuasion, general semantics, rumor transmission, propaganda, etc. Specific variables in these areas will be discussed with particular reference to their effects on the process of communication.

404 Psychology of Communication. Spring term. Credit three hours. Prerequisite: 200 or consent of instructor. M W F 9:05. Roberts 131. Mr. Barwind.
An advanced study of communication theory from a multidisciplinary orientation. Topics to be covered include: interpersonal interaction, channels of communication, and effectiveness of message. Study will include intensive analysis of primary sources of major communication theorists.

Interpersonal Communication

100 Oral and Written Communication. Fall term. Credit three hours. Not open to four-year students. Conferences by appointment, daily 8–5. M W F 8, 9:05. Warren 345. Mr. Lueder.
A program of speaking and writing designed to develop proficiency in clear effective communication. Individual appointments are scheduled to counsel the students in principles of effective expression.

205 Parliamentary Procedure. Fall or spring term. Credit two hours. Not open to freshmen. Limited to 20 students. Th 2–4:25. Roberts 301. Mr. Lueder.
Principles and practice of parliamentary procedure including formation of by-laws, and meeting evaluation. Programmed instructional materials used. Emphasis on experience in applying principles of parliamentary procedure in meeting situations.

301 Oral Communication. Fall or spring term. Credit three hours. Fall term limited to juniors and seniors; spring term open to sophomores, juniors, and seniors. Each section is limited to 20 students. Fall term: M W F 8 or 9:05, Warren 131; 10:10, Warren 231; or 11:15, Warren 245; or T Th 9:05 and W 12:20, Warren 131; or T Th 10:10 and W 12:20, Warren 345. Spring term: M W F 8, 9:05, 10:10, 11:15, Warren 131; or T Th 9:05 and W 12:20, Warren 131; or T Th 10:10 and W 12:20, Warren 345. Conferences daily 8–5. Messrs. Barwind, Earle, Freeman, Lueder and Miller.
Training and experience in the theory, preparation, presentation, and evaluation of oral topics. Designed to encourage interest in public affairs and to develop self-confidence.

Individual appointments are scheduled to counsel the students in principles of effective oral communication.

302 Advanced Oral Communication. Fall or spring term. Credit two hours. Prerequisite: 301. Fall term: T Th 11:15. Spring term: T Th 10:10, Warren 131. Conferences by appointment, daily 8–5. Staff.
Students present a variety of talks of varying lengths with emphasis on persuasive, manuscript, and visual aid speeches. The theory of persuasion and audience analysis is stressed.

303 Small Group Communication. Spring term. Credit three hours. M W 12:20–1:45. E. Roberts 222 and 223. Mr. Miller.
Theory and practice in leadership and participation in small-group communication. The course stresses learning and problem solving in the discussion setting.

Mass Media

210 Communicating Public Service Information. Fall and spring terms. Credit three hours. Freshmen and sophomores. Limited to 100 students. For non-Communication Arts majors. M W F 8. Warren 145. Mr. Lawrence.
Examines concepts, methods, techniques, and processes for communicating information to the general public. Explores use of public service time and space through broadcasting, films, publications, and other outlets. Emphasis on basic understanding of media requirements and procedures in disseminating public service information. Students will design information programs.

214 History of Mass Communication. Spring term. Credit three hours. S-U grades optional. Limited to 100 students. M W F 10:10. Warren 145. Mr. Crawford.
A survey of the history of the print, film, and broadcast media with particular emphasis on the United States. Includes an analysis of the sociological and technological factors influencing media development.

215 Introduction to Mass Media. Fall term. Credit three hours. S-U grades optional. Limited to 190 students above the freshman level. M W F 11:15. Bradfield 101. Mr. Russell.
An introductory course which explores policies, philosophies, and practices of communication media. Freedom of the press, ethics, libel, and slander are considered in the day-to-day function of the media.

311 Radio and Television Communication. Fall term. Credit three hours. Limited to 40 students. Prerequisite: 200. T Th 9:05. Roberts 131. Laboratory, T 1:25–3:25. Communication Arts Graduate Center. Mr. Colle.
Study of the problems of access to—and designing content for—radio and television. Includes analysis of program formats.

312 Advertising and Promotion. Spring term. Credit three hours. S-U grades optional. Limited to 190 students at the junior, senior, and graduate level. M 1:25–4:25. Bradfield 101. Mr. Russell.
Examines advertising principles and techniques in both a historical and an economic perspective. Advertising and promotion campaigns and their overall effectiveness as a multiplier in the economy are analyzed. Current advertising trends and the strategy of media planning are examined.

401 Communication Law. Spring term. Credit three hours. Enrollment limited to majors at the junior, senior, and graduate levels, and others by permission. M W F 11:15. Roberts 131. Mrs. Provine.

Writing for the Media

313 Writing for Magazines. Spring term. Credit three hours. Open to juniors, seniors, and graduate students. M 1:25–4:25. Communication Arts Graduate Center.
An intensive fact-writing course to help students communicate more effectively through the medium of the printed word in magazines. Art and techniques of good writing studied; continuous analysis of magazines in many fields of interest. All articles analyzed and returned to each student for rewriting and submission to a magazine.

315 News Writing and Analysis. Fall term. Credit three hours. Limited to 30 students. Lecture, T Th 11:15. Roberts 131. Laboratory, M 1:25–3:20. Communication Arts Graduate Center. Mr. Kim.
The writing and analysis of news stories. A study of press problems, press-society relations, the elements that make news, sources of news, interviewing, writing style and structure, and the reporting of public affairs. Reasonable typing ability is essential for the laboratory work.

316 Science Writing. Spring term. Credit three hours. M W F 8. Roberts 131. Mr. Kim.
In-depth interpretation of scientific subjects for general publications. The translating of scientific language to the degree necessary for reaching various publics. Analysis of issues that arise in general reporting of the news of science. Previous writing courses and/or experience are strongly recommended.

318 Radio Writing and Production. Spring term. Credit three hours. S-U grades optional. Prerequisite: 311. T 1:25–4:25. Communication Arts Graduate Center. Mr. Colle.
Writing for various radio formats, with an emphasis on public affairs programs, including documentaries and interviews. Students will tape record their programs for possible use on radio stations in the state.

319 Television Writing and Production. Fall term. Credit three hours. S-U grades optional. Limited to 25 students. Prerequisite: 311. M 1:25–4:25. Communication Arts Graduate Center. Mr. Colle.
Emphasis will be on creating several kinds of programs whose objective is to inform, educate, or persuade. Students will write and produce their own television programs which will be video-taped for playback and analysis.

420 Print Media Laboratory. Fall term. Credit two hours. Prerequisite: Either 313, 315, 316, 318, 319, or 431. Open to majors at junior and senior levels. Th 1:25–4:25. Communication Arts Graduate Center. Mr. Lawrence.
Emphasis will be placed on writing, editing, and publishing the *Cornell Countryman.*

421 Print Media Laboratory. Spring term. Continuation of 420.

Visual Communication

430 Visual Communication. Fall term. Credit three hours. Open to juniors, seniors, and graduate students. M W F 10:10. Roberts 131. Mr. Stephen.
Explores the importance of graphic arts for communicating ideas in today's visually oriented society. Examines the principles of visual communication as related to message content. Still photography, slide sets, motion pictures, TV, posters, exhibits, and other media are analyzed.

431 Art of Publication. Spring term. Credit three hours. Open to juniors, seniors, and graduate students. W 1:25–4:25. Communication Arts Graduate Center. Mr. Kim.
Designed to explore creative visual concepts to increase communication effectiveness through the printed word. Importance of selecting and coordinating format, layout, typography, and illustrations is stressed. Lectures, field trips, and assignments examine merits and problems in using publications as a communication medium.

440 Photo Communication. Fall or Spring term. Credit three hours. Limited to 25 juniors and seniors majoring in Communication Arts. Fall term: Th 1:25–4:25. Spring term: T 1:25–4:25. Communication Arts Graduate Center. Mr. Freeman.
A basic course in photography dealing with camera handling, film processing, contact proofs, projection printing, and photographic lighting. Photography as a means of communication will be emphasized during the latter part of the course. Designed for those with limited experience in photography. Students will be expected to furnish their own supplies and cameras.

International Communication

501 International Communication. Spring term. Credit three hours. M 1:25–4:25. Communications Arts Graduate Center. Mr. Crawford.
Analysis of the purposes, techniques, and effects of organizations involved in cross-national communication, with particular emphasis on the mass media—the flow of information between nations. Also considered are international conventions and other agreements that pertain to international communication.

524 Communication in the Developing Nations. Fall term. Credit three hours. Open to seniors and graduate students. W 1:25–4:25. Communication Arts Graduate Center. Mr. Crawford.
An examination of existing communication patterns and systems and their contributions to the development process. Special attention is given to the interaction between communication development and national development in primarily agrarian societies.

526 Comparative Mass Media. Fall term. Credit three hours. Th 1:25–4:25. Communication Arts Graduate Center. Mr. Colle.
A study of the mass media in several national settings with particular attention to the structure, controls, audience, and content of press and telecommunications.

Communication Seminars

512 Seminar: Interpersonal Communication. Spring term. Credit three hours. W 1:25–4:25. Communication Arts Graduate Center. Mr. Barwind.
A study of recent advances and research in leadership, small-group interaction, and communication networks. New developments will be examined as they relate to business, administration, and education.

521 Seminar: United States Communication. Fall term. Credit three hours. W 1:25–4:25. Communication Arts Graduate Center. Mr. Kim.
An examination of the structure of communication in the United States focusing particularly on the organization, content, controls and audience of the print, broadcast, and film media. Selected media of other nations are included in the analysis to provide a perspective on the United States system.

531 Studies in Communication. Fall term. Credit three hours. Limited to 15 students. Open to graduate students in communication arts; others by permission. M 1:25–4:25. Communication Arts Graduate Center. Mr. Crawford.
A review of classical and contemporary research in communication, key concepts, and

areas of investigation. Exploration of the scope of the field and the interrelationships of its various branches.

532 Methods of Communication Research. Fall term. Credit three hours. T 1:25–4:25. Communication Arts Graduate Center. Limited to graduate students. Mr. Barwind and Mr. Miller.
An analysis of the methods employed in communication research. Particular emphasis is placed on understanding the rationale for experimental, descriptive (empirical and non-empirical), and historical-critical research methods.

543 Frontiers in Communication. Spring term. Credit three hours. Th 1:25–4:25. Communication Arts Graduate Center. Mr. Colle.
A study of recent developments in communication. Emphasis is on the creative application of the newest methods, materials, and technology in visual, print, film, oral, and telecommunication media to contemporary and future problems involving communication.

550 Advanced Communication Seminar. Spring term. Credit three hours. M 7–10. Communication Arts Graduate Center. Mr. Russell and staff.
Designed to give graduate students the opportunity to study and work on special problems in communication.

590 Communication Teaching Laboratory. Fall or spring terms. Credit three hours. Time to be arranged. Enrollment limited to graduate students in the Department of Communication Arts. Prerequisite: The permission of the staff member who will supervise the work and assign the grade.
This course is designed primarily for students who wish to gain experience in teaching communication courses. Students will work with an instructor in the development of course objectives, philosophy, and planning as well as aiding with actual instruction.

Research

380H Independent Honors Research in Social Science. Throughout the year. Credit one to six hours. Open only to candidates who have met the requirements for the Honors program listed on page 11. A maximum of six credits may be earned in the Honors program.

495 Undergraduate Research. Fall and spring terms. Credit one to three hours. Open only to seniors majoring in the Department, who must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade.
Designed to permit outstanding undergraduates to carry out independent studies in communications research under appropriate supervision. Departmental staff.

595 Directed Graduate Study. Fall and spring terms. Credit three to six hours. Staff.

Education

Undergraduates may specialize in agricultural education or in science education. It is possible to combine the requirements for a Bachelor of Science degree with those for provisional certification as a teacher. Students intending to teach should consult an appropriate member of the faculty in education to ascertain requirements and to plan a program of studies.

Graduate programs are offered in educational research, foundations of education, and in specialized areas of agricultural education, science and environmental education, administration, guidance, curriculum, and continuing education.

Agricultural Education

331 Introduction to Teaching Agriculture. Spring term. Credit one hour. Required of juniors and others entering the directed teaching program in the senior or following year. M 2–4:25. Warren 261. Mr. Cushman.
An introduction to the origin, development, objectives, course of study, and method of teaching agriculture in secondary schools, and to individual experience programs.

432 Methods, Materials, and Directed Practice in Teaching Agriculture in the Secondary School. Fall term. Credit nine hours. Staff.
Directed participation in off-campus centers in specific and related problems of teaching agriculture at the junior and senior high school levels, which includes adjustment in the school and community; evaluation of area resources, materials of instruction, and school facilities; organization and development of local courses of study; launching and directing work experience programs; planning for and teaching all-day classes; advising occupational youth organizations; and other problems relating to development of a balanced program.

433 Special Problems in Agricultural Education. Spring term. Credit one or two hours. S-U grades optional. Graduate and under-Staff.
graduate students. Th 1:25–3:25. Warren 231.
The purpose is to provide students an opportunity to study individually or as a group, selected problems in agricultural education.

434 Organization and Direction of Out-of-School Programs. Fall term. Credit three hours. Mr. Cushman.
Emphasis will be placed on solving problems

encountered in such phases of the out-of-school program as determining instructional needs and planning programs of instruction, teaching in groups, giving individual instruction, organizing and advising the local out-of-school association, and evaluating the out-of-school program.

531 Supervision in Occupational Education. Fall term. Credit two hours. Offered in alternate years. Open to students with experience in teaching, or by permission. W 2:30–4:25. Plant Science 141. Mr. Bail.
The function of supervision, program planning, and supervisory techniques as applied to state programs in occupational education.

532 Advanced Methods and Materials of Teaching Agricultural and Occupational Education. Spring term. Credit two or three hours. M 2:30–4:25. Warren 101. Mr. Berkey.
Consideration is given to an analysis of selected teaching techniques and to the selection, preparation, and use of instructional materials.

533 Developing Curriculum in Agricultural and Occupational Education. Fall term. Credit three hours. M F 1:25–2:55. Warren 260. Mr. Drake.
Guiding principles, objectives, and sources of information will be developed for planning curriculum. Consideration will be given to principles, meaning, and function of occupational experience programs, and how they are planned, developed, and used as a means of instruction.

534 Education for Leadership of Youth and Adult Groups. Fall term. Credit two hours. F 1:25–3:20. Warren 101. Mr. Cushman.
Designed for leaders in the field of agricultural education who are responsible for organizing programs. A consideration of the principles involved in organizing and conducting out-of-school programs for youth and adult groups.

[535 Planning and Conducting Programs of Teacher Preparation in Agriculture. Fall term. Credit two hours. Given in alternate years. T 1:25–3:20. Warren 131. Mr. Tom. Not given in 1972–73.
Open to persons with teaching experience in agriculture who are preparing for or are engaged in the preparation of teachers, or in related educational service.]

536 Organization and Administration of Occupational Education. Spring term. Credit two hours. W 2:30–4:25. E. Roberts 223. Mr. Cushman. Given in alternate years.
Designed for teachers, high school principals, teacher trainers, supervisors, and others who are responsible for the administration of occupational programs or who wish to qualify for this responsibility. Emphasis will be placed on interpreting vocational legislation and on problems of administration at the local and state levels.

538 Teaching General Agriculture in the Secondary School. Spring term. Credit two hours. F 4:15–6. Warren 261. Mr. Tom.
The organization, purpose, and content of courses in agriculture in junior and senior high schools to serve those who elect to study agriculture for its general educational values in preparation for everyday living.

[539 Evaluating Programs of Occupational Education. Spring term. Credit two hours. Given in alternate years. Open to students with experience in teaching agriculture, or by permission. T 1:25–3:20. Comstock 145. Mr. Drake. Not given in 1972–73.
Students will study objectives and evaluative criteria, and develop criteria and procedures for evaluation of programs of occupational education in the secondary and postsecondary schools.]

630 Seminar In Agricultural Education. Spring term. Credit one hour. S-U grades only. Th 2:30–4:25. Warren 145. Staff.
Recommended for Master's degree candidates who have had teaching experience and doctoral candidates with majors and minors in agricultural education. The seminar will be primarily centered around current problems and research in the field not included in other course work.

Curriculum and Instruction

391 The Junior High School. Fall and spring terms. Credit three hours. Th 1:30–3:30. Fall term Warren 101. Spring term Warren 345. Mr. Stutz and staff.
An introduction to teaching in junior high schools with emphasis on innovative modes of teaching and curriculum design. Attention to be given to the needs and characteristics of early adolescence, affective values, goals and curriculum development, instruction and evaluation, the societal context of the school, and current developments in junior high school education.
Each student will be expected to spend time in the junior high schools and to teach briefly, if it can be arranged.

407 The Teaching of Elementary School Science. Fall term. Credit three hours. Time and place to be arranged. Registration by permission. Mr. Rockcastle.
See page 80 for description.

444 Teaching of Secondary Mathematics. Spring term. Credit three hours. T Th 4–5:15. Permission of instructor required. Warren 260. Mr. Geiselmann.
Attention will be given to research in mathematics education, and to recent proposals for curriculum revision. Special interests of the

students serve as a guide for the further selection of topics.

445 Teaching Reading and Study Skills. Spring term. Credit three hours. Limited to seniors and graduate students. Mr. Pauk.
For teachers, administrators, guidance counselors, and supervisors. Pertinent research as well as the psychology and philosophy of developmental reading and study skills will be examined. Teaching methods and sample materials for classroom use will be demonstrated and discussed.

473 Contemporary Philosophy of Education. Spring term. Credit three hours. M W 12:20–2:20. Warren 145. Mr. Gowin.
Topic for 1972–73 Structure of Knowledge.

509 Development of Curriculum in Science. Spring term. Credit three hours. For graduate students interested in elementary, secondary, or college science teaching. Limited to 20 students. M 1:25–4:25. Mr. Novak.
See page 81 for description.

531 Supervision in Occupational Education. Fall term. Credit two hours. Offered in alternate years. Open to students with experience in teaching, or by permission. W 2:30–4:25. Mr. Bail.
See page 74 for description.

532 Advanced Methods and Materials of Teaching Agricultural and Occupational Education. Spring term. Credit two or three hours. M 2:30–4:25. Warren 232. Mr. Berkey.
See page 74 for description.

533 Developing Curriculum in Agricultural and Occupational Education. Fall term. Credit three hours. M F 1:25–2:55. Warren 260. Mr. Drake.
See page 74 for description.

540 The Art of Teaching. Fall and spring term. Credit and hours as arranged. S-U grades optional. Students may register only with the consent of the instructor. Professor Wardeberg.
For students enrolled in teacher education programs.

545 The Curriculum of American Schools. Fall term. Credit three hours. Limited to graduate students.
A survey of the basic elements involved in making curriculum decisions, and an examination of contemporary curriculum developments in elementary and secondary schools.

[546 Teaching Reading and Language Skills. Fall term. Credit three hours. T Th 2:30–3:45. Warren 231. Miss Wardeberg. Not given in 1972–73.
Materials and techniques in teaching the language arts in the elementary school; special emphasis on the teaching of reading.]

547 Seminar in Elementary Education. Fall term. Credit and hours to be arranged. S-U grades optional. Miss Wardeberg.
A problems seminar to study current problems and research in this field.

565 Supervision of Instruction. Spring term. Credit three hours. Miss Wardeberg.
See page 76 for description.

573 Structure of Knowledge. Spring term. Credit three hours. M W 11:15. Warren 145. Mr. Gowin.
The concept of the structure of a discipline and the development of a systematic method for the analysis of knowledge claims are the main concerns of this seminar. These concerns are related to the nature of teaching, curriculum theory and research, educational policy and nontraditional forms of educational practice.

594 College Teaching. Spring term. Noncredit. Members of the University staff.
Designed for those who plan to teach In college and universities. Concepts and methods of teaching, organization of subject matter, motivation, learning, testing, grading, and similar problems are treated.

645 Seminar in Curriculum Theory and Research. Spring term. Credit three hours. S-U grades optional. Registration by permission of instructor. T 1:25–3:30. Caldwell 250-A. Staff.

Educational Administration

527 Evaluation for Program Management. Fall term. Credit three hours. S-U grades optional. Time to be arranged. Mr. Bruce.
See page 78 for description.

531 Supervision in Occupational Education. Fall term. Credit two hours. Offered in alternate years. Open to students with experience in teaching, or by permission. W 2:30–4:25. Plant Science 141. Mr. Bail.
See page 74 for description.

561 Administration of Educational Organizations. Fall term. Credit three hours. M W 1:25–3:00. Warren 231. Mr. Haller.
A consideration of current approaches to understanding administration and organizations, and their application to the educational setting.

562 The Principalship. Spring term. Credit three hours. Th 2:30–4. Bradfield 105. Mr. Hixon.
Organized to enable recognition and cognition of the administrative functions essential to effective elementary and secondary schools. Analysis will include the elementary and secondary school as institutions, innovation in organization and curriculum, administration of instructional and noninstructional personnel, and community relationships. Each student will elect to specialize at the elementary or secondary school level for an

individually planned program of intensified study.

563 Sociology of Education. Spring term. Credit three hours. M W 1:25–3. Warren 131. Mr. Haller.
Introduction to major themes in the contemporary literature in the sociology of education. These include social stratification and education, the school as an organization and as an institution, minority groups in the school, socialization, professionalization of teaching, bureaucratization, the teacher-student roles and the career patterns of teachers.

564 Economic Issues in Education. Fall term. Credit three hours. M 2:30–4:25. Warren 131. Staff.
Introduction to problems of resource procurement and allocation in education. Attention will be focused on existing and alternative strategies of fiscal support for schools and new management techniques for allocating such resources.

565 Supervision of Instruction. Spring term. Credit three hours. T 2–4. Warren 345. Miss Wardeberg.
A basic course in the nature and scope of supervision. Open to those already in supervisory positions, either in public schools or elsewhere, and experienced persons aspiring to become supervisors.

567 Education Law. Fall term. Credit three hours. T 2:30–4:25. Comstock 145. Mr. Hixon.
Review and analysis of federal and state legislation, court decisions, opinions, and regulations which affect educational institutions. Attention to New York State legislation is optional.

569 Personnel Administration. Fall term. Credit three hours. For graduate students only. Th 4–6. Warren 261. Mrs. Egner.
Designed to provide an introduction to modern psychological and sociological perspectives of personnel administration. Three purposes are paramount: (1) to acquaint the student with a variety of ways of conceiving the problems of personnel administration; (2) to acquaint the student with relevant research; and (3) to develop some facility in the analysis of conceptual schemes and research projects.

663 Seminar in the Sociology of Education. Fall term. Credit three hours. Consent of instructor required. T 2:30–4:30. Plant Science 141. Mr. Haller.
Consideration of selected topics in the sociology of education.

668 Seminar in Educational Administration. Spring term. Credit three hours. Prerequisite: consent of instructor. Time to be arranged. Mrs. Egner.
Consideration of problems and policy issues in public schools and higher education.

669 Studies in Educational Administration. Fall and spring terms. Credit one hour. For graduate students only. Consent of instructor required. Th 4–6. Warren 131. Mr. Haller and staff.
This course is intended to provide beginning graduate students in educational administration with a critical introduction to research topics in this field and to inform them of the potential of those topics for thesis research.

Educational Psychology and Measurement

110 General Psychology. Fall or spring term. Credit three hours. May not be taken for credit by students who have had Psychology 101 or equivalent. Two lectures, a testing and demonstration period, and one discussion section each week. Lecture and testing period, M W F 10:10. Comstock 245. Discussion sections, Th or F 8, 9:05, 10:10, 11:15, 12:20, 1:25, 2:30, or 3:35. E. Roberts 223. Mr. McConkie.
A survey of research and theories in the field of psychology. Areas of emphasis include research methods, perception, learning and memory, language and thought, motivation and emotion, individual differences and psychological testing, personality development, and abnormal psychology.

411 Educational Psychology. Fall or spring term. Credit three hours. Freshmen and sophomores not admitted. Registration limited to 100 students. Prerequisite: an introductory course in psychology. Designed for students in teaching programs and/or those interested in the educational process. Fall term, M W F 11:15. Warren 131. Mr. Ripple. Special section for students in agricultural education, fall term only, time to be arranged. Mr. Glock. Spring term, time to be arranged. Mr. Glock. Tutoring recommended during spring term. (Equivalent to Psychology 103.)
Consideration of the outstanding facts and principles of psychology bearing upon classroom problems.

417 Psychology of Adolescence. Spring term. Credit three hours. Freshmen and sophomores not admitted. Registration limited to 100 students. Prerequisite: an introductory course in psychology. T Th 1:25–3:20. Bradfield 101. Mr. Ripple.
A survey of the nature of adolescent growth and development, with emphasis on some of the causal factors pertaining to adolescent behavior.

452 Interpretation of Statistics Used in Education. Fall or spring term. Credit one hour. T 12:20. Warren 101. Will be offered in the spring term only to those students concur-

rently enrolled in course 453. Time to be arranged. Mr. Millman.
See description in next column.

453 Introduction to Educational Statistics. Spring term. Credit three hours. Prerequisite: 452 (may be taken concurrently), or permission of the instructor. T Th 8–9:55. Warren 101. Mr. Millman.
See description in next column.

511 Educational Psychology. Fall term. Credit three hours. Permission of instructor required. Prerequisite: an introductory course in psychology. M W F 11:15. Warren 260. Mr. Ripple.
A basic course in educational psychology for graduate students.

551 Educational Measurement. Spring term. Credit three hours. Not offered every year. Permission of the instructor required. Hours to be arranged. Mr. Glock.
A study of the construction of achievement tests and the use of aptitude tests, achievement tests, and other measuring instruments in the classification and guidance of pupils and improvement of instruction.

555 Use and Interpretation of Tests in Guidance and Personnel Administration. Fall term. Credit three hours. Th 4–6. Warren 160. Mr. Andrus.
Open to students in guidance or personnel administration and to classroom teachers who expect to work with standardized group tests. Deals with the historical development and the use and interpretation of aptitude tests as a basis for guidance and selection in public schools, colleges, and/or industry. Designed to meet the New York State certification for guidance counselors.

599 Methods of Educational Inquiry. Fall term. Credit three hours. Prerequisite: one course in statistics or 452 taken concurrently. T Th 2:30–4. Bradfield 101. Mr. Millman and staff.
See description in next column.

613 Seminar in Educational Psychology. Fall term. Credit three hours. Permission of instructor required. Hours to be arranged. Mr. Glock.
Theoretical issues in the teaching of reading.

617 Seminar in Learning and Memory. Fall term. Credit three hours. Prerequisite: Psychology 306 or equivalent. Hours to be arranged. Mr. McConkie.
A study of current issues in the learning, retention, and transfer of verbal information.

618 Seminar in Educational Psychology. Spring term. Credit three hours. Permission of the instructor required. Hours to be arranged. Mr. Ripple and staff.
Emphasis on theoretical considerations of various areas in educational psychology. Primarily for doctoral students.

Educational Research Methodology

452 Interpretation of Statistics Used in Education. Fall and spring terms. Credit one hour. Registration in spring term limited to those concurrently enrolled in 453. Fall term. T 12:20. Warren 201. Spring term. Time to be arranged. Mr. Millman.
A brief introduction to the vocabulary and symbolism used in reporting empirical research in education. Both univariate and multivariate statistical procedures will be covered from an intuitive point of view.

453 Introduction to Educational Statistics. Spring term. Credit three hours. Prerequisite: 452 (may be taken concurrently), or permission of the instructor. T Th 8–9:55. Warren 101. Mr. Millman.
A study of common statistical procedures encountered in educational literature and research. The course includes the mathematical bases, computation, and interpretation of univariate and multivariate descriptive and inferential statistics.

527 Evaluation for Program Management. Fall term. Credit three hours. S-U grades optional. M 1:25–3:20, and one hour to be arranged. Caldwell 250A. Mr. Bruce.
See page 78 for description.

551 Educational Measurement. Spring term. Credit three hours. Permission of the instructor required. Not offered every year. Mr. Glock.
See description in previous column.

599 Methods of Educational Inquiry. Fall term. Credit three hours. Prerequisite: one course in statistics or 452 taken concurrently. T Th 2:30–4. Bradfield 101. Mr. Millman and staff.
An introduction to the methods that underlie the conduct of significant research in education. Emphasis will be placed upon describing and analyzing such procedures as forming concepts, developing educational products, making observations and measurements, performing experiments, building models and theories, providing explanations, and making predictions.

616 Seminar in Educational Research. Fall term. Credit three hours. Prerequisite: courses 453 and 599 or permission of the instructor. Time to be arranged. Mr. Millman.
Topic to be arranged.

698 Practicum in Educational Research. Fall and spring terms. Three to six credit hours per term. Hours to be arranged. Members of the staff.
Participation in a research project under the direction of the principal investigator of said project. Level of responsibility will increase with the experience and capability of the

candidate, the eventual goal being his assumption of responsibility for a portion of the research.

699 Conceptual Problems in Educational Inquiry. Fall term. Credit three hours. Primarily for doctoral candidates in their second year of residence. Prerequisite: 599 or equivalent, or permission of instructor. W 2:30–4:30. Warren 131. Mr. Gowin and Mr. Strike.
An examination of such concepts as causation, operationism, validity, reliability, hypothetical construct, generalization, explanation, probability, and hypotheticodeductive method.

Extension and Continuing Education

Other departments that offer additional courses helpful in the field of extension education are Community Service Education, Rural Sociology, Sociology, Agricultural Economics, and Anthropology.
Extensive flexibility is permitted each student in the selection of a course program to meet his special interests and professional needs.

522 Educating for Community Action. Spring term. Credit three hours. Open to juniors and seniors by consent. W 11:15–1:10; F 11:15. Caldwell 250A. Mr. Bruce.
Emphasis is on the design and execution of the educational aspects of community action programs. The course deals with the identification and statement of educational goals, selection of teaching strategies, and evaluation of outcomes.

523 Administration of Continuing Education Programs. Spring term. Credit three hours.
An application of the principles of administration and supervision to the problems of organizing and operating continuing education programs. W 1:25–4:00. Bradfield 105. Mr. Broadwell and Mr. Durfee.
Emphasis is on identifying, describing, and analyzing alternative models for planning, organizing, staffing, directing, controlling, and financing an adult education enterprise.

524 Designing Extension and Continuing Education Programs. Fall term. Credit three hours. T 1:25–4. E. Roberts 223. Mr. Leagans.
Analysis of current theories, concepts, principles, and procedures central in the process of developing programs for the continuing education of adults. Emphasis is placed on such major problems as situation analysis, selecting objectives from alternatives, creating support at macro level, organizing program resources at micro level, and planning for program execution.

525 Educational Communication. Spring term. Credit three hours. T 1:25–4:00. E. Roberts 223. Mr. Leagans.
Emphasizes the centrality of useful technology and effective communication in continuing education programs. Emerging models of the communication process are reviewed as a framework for analyzing major elements, including communicator credibility, program content, messages, organization and use of transmission channels, message treatment, audience identification, feedback, and the design of operation communication programs.

526 Practicum in Continuing Education. Continuous fall and spring terms. Credit one to three hours. Open only to graduate majors and minors in extension and continuing education. Hours to be arranged. Staff.
Provides opportunity for students to supplement the formal aspects of their curriculum through systematic participation in an ongoing continuing education program.

527 Evaluation for Program Management. Fall term. Credit three hours. S-U grades optional. Time to be arranged. Mr. Bruce.
Program evaluation is treated as a part of the overall task of making program management decisions. Primary attention is given to educational and other community change programs, but inferences to other program management tasks are possible. The course has three aspects: (1) a series of lecture-discussions; (2) a continuing workshop; and (3) individual student evaluation projects.

626 Divisional Seminar. Continuous fall and spring terms. Credit one hour each term optional. S-U grades optional. For all majors in extension and continuing education and community service education, and open to minors. Staff.
Provides opportunity for divisional students and staff jointly to analyze and reflect on current professional issues.

627 Seminar: Behavioral Change in International Rural Modernization. Spring term. Credit two hours. Time and place to be arranged. Mr. Leagans.
Analysis of concepts and strategies for repatterning human behavior at both the macro and micro levels. Changes in human behavior are viewed as a dependent variable in the rural development process.

628 Seminar: Current Problems and Issues in Extension Education. Spring term. Credit two hours. Time and place to be arranged. Open by permission of the instructor to graduate students in extension education and other fields with special relevance to the seminar topic. Staff.
A major area of concern to extension education will be selected for intensive study by participating students and faculty.

CSE 411 Introduction to Adult Education.
See the *Announcement of the College of Human Ecology.*

Guidance and Personnel Administration

580 Student Culture in the American College. Spring term. Credit three hours. Prerequisite: consent of the instructor. T Th 1:25–2:25. Plant Science 141.
Study of the student culture in the American college with emphasis on current research.

581 Student Personnel Administration. Fall term. Credit three hours. Prerequisite: permission of the instructor. T Th 1:25–2:45. Warren 131.
Analysis of the objectives, functions, and organization of student personnel services in higher education. Emphasis on behavioral science theories supporting student personnel administration.

582 Educational and Vocational Guidance. Fall term. Credit two hours. For graduate students only. T 4:15–6. Warren 160.
Principles and practices of educational and vocational guidance. Historical and theoretical background of the guidance movement; educational, vocational, and community information needed; study of the individual; group methods; counseling; placement and follow-up; organization, administration, and appraisal of guidance programs.

583 Counseling. Fall term. Credit three hours. Prerequisite, 555 or equivalent (may be taken concurrently), and consent of instructor. M W 9:05–11. Caldwell 250A. Mr. Hedlund.
The counseling process viewed from selected theoretical systems. Differentiation of the counselor's role and counseling objectives between systems through the use of case studies.

584 Group Counseling. Spring term. Credit three hours. Prerequisite, consent of instructor. M W 9:05–11. Caldwell 250A. Mr. Hedlund.
Techniques and principles of counseling with groups. Emphasis on the relationship between types of counselor interventions and the development of group processes.

602 Field Laboratory in Student Personnel Administration. Fall or spring term. Credit and hours to be arranged. Prerequisite: consent of instructor. Staff.
Directed field project in student personnel administration.

681 Seminar in Student Personnel Administration. Fall or spring term. Credit as arranged. S-U grades optional. Prerequisite: permission of instructor. F 9:05–11. Caldwell 250A. Mr. Hedlund.
Topic varies.

The following courses are not ordinarily offered on campus during the academic year, but they *are* offered in alternate summer sessions.

585 Occupational and Educational Information. Credit four hours.

586 Organization and Administration of Guidance Programs. Credit two hours.

587 Practicum in Measurement and Appraisal for Counselors. Credit two hours.

588 Case Studies in Counseling. Credit two hours.

History, Philosophy, and Sociology of Education

470 Educational Issues. Every term. Credit three hours. S-U grades optional. Registration in afternoon sections limited to 25 students. M W F 10:10. Warren 260 or T Th 2:30–4. Fall Term: Warren 145. Spring Term: Warren 131. Messrs. Gowin, Strike and Stutz.
A critical examination of theories, policies, and practices.

[471 Logic in Teaching. Spring term. Credit three hours. Consent of instructor required. Given in alternate years. T Th 2:30–4. Bradfield 101. Mr. Strike. Not given in 1972–73.
A consideration of definition, explanation, proof, and the nature of knowledge as they bear upon classroom teaching.]

472 Philosophers on Education. Fall term. Credit three hours. For graduates and advanced undergraduates. Consent of instructor required. M W 2:30–4. Plant Science 37.
Selected writings by such philosophers as Plato, Descartes, Rousseau, and Dewey will be examined in their own right and for the light they throw on the persistent problems in education.

473 Contemporary Philosophy of Education. Spring term. Credit three hours. M W 12:20–2:20. Warren 145. Mr. Gowin.
Topic for 1972–73: Structure of Knowledge.

475 Freedom and Authority in Education. Spring terms. Credit three hours. Given in alternate years. T Th 2:30–4. Plant Science 37. Mr. Strike.
An analysis of the concept of freedom in both political and psychological contexts and an application of the resulting analysis to problems of freedom and authority in education.

563 Sociology of Education. Spring term. Credit three hours. M W 1:25–4. Warren 131. Mr. Haller.
See page 76 for description.

573 Structure of Knowledge. Spring term. Credit three hours. M W 11:15. Warren 145. Mr. Gowin.
See page 75 for description.

[574 History of American Education. Fall term. Credit three hours. For graduate students; seniors admitted with permission of the

instructor. M 4–6. Warren 260. Mr. Stutz. Not given in 1972–73.
An examination of the role of education in shaping American society. Chief emphasis will be on the period from 1820 to 1914.]

578 Comparative Education. Fall term. Credit three hours. For graduate students. M 4–6. Warren 260. Mr. Stutz.
A comparative treatment of several national systems of education from a historical perspective.

598 Education as a Field for Inquiry. Fall term. Credit three hours. Graduate students only. W 2:30–4. Warren 232. Instructor to be appointed.
Designed primarily for students without previous training or experience in the field of education, this course is intended to provide insight into the nature and content of the field to which their research efforts will be directed. Deals with the structure of the educational enterprise, its history, its objectives and the ways it seeks to achieve them, its main concerns, emphases, and sources of strain.

663 Seminar in the Sociology of Education. Fall term. Credit three hours. Consent of instructor required. T 2:30–4:30. Plant Science 141. Mr. Haller.
See page 76 for description.

670 Seminar in the College and University. Spring term. Credit three hours. S-U grades optional. Mr. Gowin and staff.
Conditions of disciplined inquiry in higher education.

671 Seminar: Analysis of Educational Concepts. Spring term. Credit three hours. Admission by consent. W 10:10–12. Warren 361. Mr. Strike.
Topic for 1972–73: Liberalism. Studies of ideologies and educational policies.

672 Seminar in Educational Classics. Spring term. Credit three hours. Admission by consent.
Topic for 1972–73: to be announced.

673 Seminar on Dewey. Fall term. Credit three hours. Consent of instructor required. T 12:20–2:20. Warren 260. Mr. Gowin.
Primary aim is a critical understanding and appraisal of Dewey's philosophy, especially as it centers upon education.

674 Seminar in History of Education. Spring term. Credit three hours. Admission by consent. M 3:35–5:35. Plant Science 141. Mr. Stutz.
Topic for 1972–73 to be announced.

699 Conceptual Problems in Educational Inquiry. Fall term. Credit three hours. Primarily for doctoral candidates in their second year of residence. Prerequisite: 599 or equivalent, or permission of instructor. W 2:30–4:30. Warren 131. Mr. Gowin and Mr. Strike.
See page 78 for description.

Science and Environmental Education

401 Our Physical Environment. Fall or spring term. Credit three hours. Open only by written permission of the instructor. Limited to 18 students. Lecture, T 1:25. Practical exercises, T 2:30–4:25 and one other period to be arranged. Stone 7. Mr. Rockcastle.
A study of the commonplace phenomena and substances in our physical environment, and their use in demonstrating basic scientific principles. Frequent field trips and firsthand examination will be used in studying air, water, soil, light, and sound, as well as some elementary mechanical and electrical devices. Emphasis will be placed on the physical environment as an aid to teaching the physical sciences in the public secondary schools.

[402 Literature in Conservation and Environmental Education. Spring term. Credit two hours. Open only to students above sophomore rank. T Th 11:15. Stone 7. Mr. R. B. Fischer. Not given in 1972–73.
An examination of books, periodicals, and reports dealing with historical and present aspects of environmental quality and education. Students are involved in planning and offering the lectures, discussions, and literature reports.]

[403 Environmental and Natural History Writing. Fall term. Credit two hours. Open to students above sophomore rank. T Th 11:15. Stone 7. Mr. Fischer. Not given in 1972–73.
For persons who wish to improve their ability to reach and influence others by publishing in magazines and newspapers. The class produces a weekly column for a local newspaper, in addition to other types of articles. Subject matter, outlets for articles, news releases, posters, newsletters, and brochures are dealt with. A working knowledge of biology and ecology is assumed.]

404–405 Field Natural History. Fall or spring terms. Credit three hours. May be taken either term or both terms. Limited to 40 students. Lecture, M 10:10. Stone 7. Weekly field trips and lecture, T or Th 1:30–4:30. Mr. Fischer.
Devoted to studies of Northeastern plants and animals, their biology, ecology, and their use in the environmental education programs of interpretive centers, schools, and field biology courses. Man's impact on plant and animal communities is stressed. A methods and materials course.

407 Teaching of Elementary School Science. Fall and spring terms. Credit three hours. Registration by permission. Limited to 18 students. Lecture, W 1:25. Practical exercises, W

2:30–4:25 and one other period to be arranged. Stone 7. Mr. Rockcastle.
The content and methods of elementary school science, with field work and laboratory emphasis on modern and experimental curricula. Includes class observation and experimentation. Designed particularly for those who are preparing to teach or supervise elementary school science.

408 Methods of Teaching Science in Secondary Schools. Fall or spring term. Credit three hours. For juniors, seniors, and graduate students without teaching experience. Prerequisite: 411 or the equivalent or concurrent registration. Open to students in science education intending to register for 409; permission of instructor required for all others. Limited to 20 students per section. Fall term: M W F 8. Stone 7. Hours for observation to be arranged. Spring term: M W F 8. Stone 7. Mr. Brautigan.
Consideration of current methodology, newly developed curricula, and materials for teaching science in secondary schools. Attention is given to the aims and goals of science instruction in relation to classroom techniques. Systematic observations in local schools. Use of video tapes.

409 Practice in Teaching Science in Secondary Schools. Fall or spring term. Credit six or twelve hours. Prerequisite: 408 and permission of the instructor. Hours to be arranged. Mr. Brautigan and staff.
Supervised practice in teaching science in secondary schools, with frequent conferences. Special seminars scheduled in conjunction with practice teaching. Multimedia forms of feedback information concerning the classroom performance will be provided to the practice teacher.

507 The Teaching of Science. Fall term. Credit three hours. For graduate students interested in elementary, secondary, or college science teaching. Limited to 20 students. M 1:25–4:25. Stone 7. Mr. Novak.
A consideration of learning theory as applied to problems of selection and organization of subject matter, methods of teaching and instructional innovation. Study of published research relevant to the improvement of science teaching. Course is conducted in a seminar style.

509 Development of Curriculum in Science. Spring term. Credit three hours. For graduate students interested in elementary, secondary, or college science teaching. Limit 20 students. M 1:25–4:25. Stone 100. Mr. Novak.
Study of new science curriculum programs, including philosophy and rationale of the programs. Observation of classes using new materials. Concentrated study of science curriculum development in the area of individual student's interest. Course is conducted in a seminar style.

606 Science Education Seminar. Fall or spring term. Credit one hour. S-U grades only. For all graduate students who major or minor in this division. M 4:30–6. Stone 7. Messrs. Brautigan, Fischer, Novak, and Rockcastle.

General Education

380H Independent Honors Research in Social Science. Throughout the year. Credit one to six hours. Open only to candidates who have met the requirements for the Honors program listed on page 11. A maximum of six credits may be earned in the Honors program.

499 Informal Study in Education. Maximum credit three hours each term. S-U grades optional. Staff.
This privilege is granted to a qualified junior, senior, or graduate student, when approved by an adviser from the Education staff who is personally responsible for the study. Undergraduates must attach to their preregistration material, written permission from the staff members who will supervise the work and assign the grade. Two purposes are sanctioned: (1) to engage in a study of a problem or topic not covered in a regular course; or (2) to undertake tutorial or honors study of an independent nature in the area of the student's research interests. The privilege is not designed to engage in a study supplementary to a regular course for the purpose of increasing the content and credit allocation of the course.

500 Special Studies. Credit as arranged. S-U grades optional. Limited to graduate students working on theses or other research projects. Each registration must be approved by a staff member who will assume responsibility for the work. Members of the staff.

600 Internship in Education. Fall and spring terms. Credit two to six hours, as arranged. Members of the faculty.
Opportunity for apprentice or similar practical experience on the graduate level in educational administration, agricultural education, guidance, personnel administration, supervision, and other types of professional service in education.

Entomology

The Department of Entomology offers the major in entomology, which provides a background for careers in research, teaching, public service, and commercial fields, where knowledge of entomology is utilized. Students are accepted as majors in entomology upon the consent of the chairman or the department advisers.

The Department occupies Comstock Hall and Caldwell Hall, as well as insectary

buildings with growth chambers and greenhouses. These facilities include an outstanding entomological library and an excellent insect collection. Some specialized laboratories such as Dyce and Schwardt are located nearby, off campus.

General Entomology

210 Introductory Entomology. Spring term. Credit three hours. S-U grades optional for students not specializing in entomology. Prerequisite: Biological Sciences 101–102 or 107–108, or their equivalent. Lectures, T Th 10:10. Comstock 245. Laboratories, M T W Th 2–4:25. Comstock 100. Mr. Raffensperger and assistants.
A survey of the structure, biology, and classification of insects; an introduction to the study of insects as a major segment of the biological community, with attention to representative species of economic importance, the techniques and consequences of their control. Laboratory exercises in the anatomy and biology of insects and practice in the techniques of insect identification.

212 Insect Biology. Fall term. Credit three hours. Prerequisite: Biological Sciences 101–102 or concurrent registration or their equivalent. Lectures, W F 11:15. Savage 100. Laboratory, W Th or F 2–4:25. Comstock 100. Mr. Eickwort and assistants.
Designed to introduce the science of entomology by focusing on the basic principles of the systematics, morphology, physiology, behavior, and ecology of insects. The laboratory in early fall includes field trips to collect insects and study them in their natural environment. A small collection stressing ecological categories is required.

518 Techniques of Biological Literature. Fall term. Credit two hours. Given in alternate years. Lectures, T Th 9:05. Comstock 300. Mr. Franclemont.
History of the development of entomological literature and critical study of the biologists' works of reference. Practice in the use of indices and bibliographies and practice in the preparation of the latter.

[521 Acarology. Fall term. Credit four hours. Prerequisite: 210 or 212 and permission of instructor. Lectures, M F 10:10. Laboratories, M F 1:25–4:25. Comstock 270. Mr. Eickwort. Not given 1972–73.
An introduction to the taxonomy, morphology, and bionomics of mites and ticks, with emphasis on taxa of economic importance. A collection will be required.]

Insect Morphology

322 Insect Morphology. Fall term. Credit four hours. Prerequisite: 210 or 212 and permission of instructor. Lectures, M F 10:10. Laboratories, M F 1:25–4:25. Comstock 270. Mr. Eickwort.
An introduction to the external and internal anatomy of insects, with emphasis on the comparative and functional aspects. The laboratory is devoted largely to dissection.

Insect Taxonomy

331 Introductory Insect Taxonomy. Spring term. Credit three hours. Prerequisite: 210 or 212. Lecture, Th 10:10. Laboratories, T Th 2–4:25. Comstock 300, Mr. Franclemont.
An introduction to the systematics and distribution of insects. Laboratory practice in the identification of orders, families, and representative genera of insects; methods of collection and preparation of insect specimens. Field trips are taken in the late spring.

[531 Taxonomy of the Smaller Orders of Insects. Fall term. Credit three hours. Given in alternate years. Prerequisite: 311. Discussion, F 10:10. Laboratories, F 2–4:25 and one other by arrangement. Comstock 300. Mr. Brown. Not given 1972–73.
Discussions of the classification, evolution, and bionomics of the orders and families of insects, exclusive of the larger orders of Holometabola. Laboratory studies on the literature and on the characters and classification of representative genera and species. Continuation of taxonomy of Holometabola is in courses 532, 533, and 534.]

532 Taxonomy of the Immature Stages of Holometabola. Fall term. Credit three hours. Given in alternate years. Prerequisite: 531 or permission of the instructor. Lecture, W 10:10. Laboratories, W F 2–4:25. Comstock 300. Mr. Franclemont.
Lectures on structure and habits of insect larvae. Laboratory studies of the literature, comparative morphology, and identification of the immature stages of the Holometabola.

533 Taxonomy of the Coleoptera and Lepidoptera. Spring term. Credit three hours. Given in alternate years. Prerequisite: 331. Lecture, W 10:10. Laboratories, W F 2–4:25. Comstock 300. Mr. Franclemont.
Laboratory studies on the literature and on the character and classification of representative genera and species of these orders.

[534 Taxonomy of the Diptera and Hymenoptera. Spring term. Credit three hours. Given in alternate years. Prerequisite: 331. Lecture, W 10:10. Laboratories, W F 2–4:25, and one other by arrangement. Comstock 300. Mr. Brown. Not given 1972–73.
Laboratory studies on the literature and on the characters and classification of representative genera and species of these orders.]

Evolutionary Theory (Biological Sciences 475).

Economic Entomology

441 Principles of Economic Entomology. Fall term. Credit three hours. Prerequisite: 210 or 212 or the equivalent. Enrollment limited. Lectures, T Th 11:15. Comstock 145. Laboratory, T 2–4:25. Comstock 100. Several all-afternoon field trips by arrangement. A collection of economically important insects is required. Instructor to be appointed.
Principles in the management and control of insect populations.

442 Pesticide Technology. Spring term. Credit three hours. Prerequisite: 411 or equivalent. Lectures M W F 11:15. Comstock 145. Mr. Dewey.
Selected topics concerned with the practical use of pesticide chemistry including formulation, application, safety procedures and environmental considerations, as well as the problems of residues and the legal aspects of insecticide development and regulation.

541 Experimental Methods in Economic Entomology. Fall term. Credit three hours. Given in alternate years. Designed primarily for graduate students but open to qualified undergraduates. Prerequisites: 210 or 212 or equivalent, and Plant Breeding 510. Enrollment limited. Permission to register is required. Lectures: M W F 11:15. Comstock 245. Laboratory and field trips to be arranged. Mr. Gyrisco.
An advanced course dealing with the principles and methods of insect control and experimentation. Emphasis will be placed on instrumentation and its use in modern methods of insect control, biology, and applied ecology. Field plot designs, field techniques, analysis of data, practical sampling methods, regulations concerning pesticide residues on field crops and in milk and meat, and effects of pesticides on pollinators will be stressed. Soil insects, small grain insects, and forage insects will be used largely as examples.

Parasitology

[361 Introductory Parasitology. Spring term. Credit four hours. Prerequisite: Biological Sciences 101–102 or their equivalent. Course 210 or 212 and Biological Sciences 371 are also recommended. Limited to 12 students per section. Lectures, M W 10:10. Comstock 145. Laboratories, M W or T Th 2–4:25. Comstock 200. Instructor to be appointed. Not given in 1972–73.
An introduction to the symbiotic ways of life among animals, primarily the protozoan, helminth, and arthropod species of temperate and tropical areas. Special emphasis is given to the recognition of selected symbiotic species and how they live with their hosts.]

[551 Advanced Parasitology (Protozoa and Helminths.) Fall term. Credit three hours. Given in alternate years. Undergraduates only by permission. Prerequisite: 351 or its equivalent. Lecture and one laboratory, T 1:25–4:25 and Th 2–4:25. Comstock 200. Instructor to be appointed. Not given in 1972–73.
A continuation of 351 for graduate students interested in the parasitic protozoa and helminths. Practical experience with methods of collection, preparation; detailed studies on recognition and life cycles. Special emphasis is given to the parasites that are transmitted by arthropods in the tropics.]

[552 Advanced Parasitology (Medical Entomology). Fall term. Credit three hours. Given in alternate years. Undergraduates only by permission. Prerequisite: 351 and 212 or their equivalent. Lecture and one laboratory, T 1:25–4:25 and Th 2–4:25. Comstock 200. Instructor to be appointed. Not given in 1972–73.
A continuation of 351 for graduate students interested in medical or veterinary entomology. Practical experience with methods of collection, preparation; detailed studies on recognition, life cycles, and control. Special emphasis is given to causative agents, vectors, and intermediate hosts of disease-producing organisms. The study examples include species of worldwide distribution, especially those of tropical areas.]

553 Advanced Parasitology (Insect Pathology). Spring term. Credit three hours. Prerequisite: a course in entomology, a course in microbiological science, and permission of instructor. Lectures and discussion, M W F 10:10. Comstock 145. Mr. Kramer.
A survey of the microbial and zooparasitic diseases of insects with emphasis on the natural history of the pathogens. Pathogens considered include viruses, rickettsiae, bacteria, spirochetes, fungi, protozoa, nematodes, and selected arthropods.

Apiculture

260 Introductory Beekeeping. Spring term. Credit two hours. T Th 11:15. Comstock 245. Mr. Morse.
Intended to afford a general knowledge of the fundamentals of beekeeping including the life history, instincts, and general behavior of honey bees. Special attention is given to the role of bees in the cross-pollination of agricultural crops as well as production of honey and beeswax.

262 Biology of the Honey Bee. Fall term. Credit one hour. Limited to 10 students. Registration by permission only. Fifteen laboratories by arrangement in September and October only. Mr. Morse.
A laboratory and field course in which the classical experiments on the vision, chemical senses, and language of the honey bee, as described by von Frisch, are repeated. Lab-

oratories include demonstration of the sex attractant, swarm orientation, the natural nest, and a study of wasp, bumble bee, and other social insect nests.

Environmental Biology

General Ecology (Biological Sciences 361).

471 Bionomics of Fresh-Water Invertebrates. Spring term. Credit three hours. Prerequisite: Entomology 210 or 212. Biological Sciences 361 is recommended. Lecture: F 10:10. Comstock 145. Laboratories: F 2–4:25, S 8–10:25. Comstock 200. Mr. Berg.
A field and laboratory study of the bionomics of fresh-water invertebrates. The course includes characteristics of fresh-water habitats, identification of insects and other invertebrates found in them, understanding of life cycles, and consideration of the ecological relationships among organisms in various aquatic biotopes.

672 Seminar in Aquatic Ecology. Fall term. Credit one hour. Given in alternate years. Prerequisite: Entomology 471 or Biological Sciences 462, and permission of instructor. Time and place to be arranged. Mr. Berg.
Discussions and analysis of current concepts and problems in limnology and aquatic entomology, including the critical study of selected reference works and research papers.

[577 Biological Control. Fall term. Credit three hours. Consent of instructor is required. T Th 9:05. Place to be arranged. Mr. Tauber. Not given in 1972–73.
Participants will critically review theory and method of biological control of arthropod pests and weeds.]

595 Environmental Biology and Population Management. Fall and spring terms. Credit one hour. Prerequisite: permission to register. Time and place to be arranged. Mr. Pimentel.
The ecological principles concerned with the management and control of populations. Emphasis will be placed on current problems of environmental pollution.

660 Insect Ecology (Field Course). Spring term. Credit two hours. Prerequisite: courses in ecology, entomology, and taxonomy. Consent of instructor is required. T 8 p.m. Caldwell 382. The class will be away from campus from March 18–April 3. Mr. Root.
A field course stressing the methods for study of insect populations and communities. The class will engage in a coordinated set of projects at the Archbold Field Station and Everglades National Park in Florida.

[662 Insect Behavior Seminar. Spring term. Credit one hour. Prerequisites: Entomology 210 or 212 and Biological Sciences 320 or equivalent. T 4:00 p.m. Caldwell 192. Mr. Eickwort and Mr. Tauber. Not given 1972–73.]

Ecology of Pest Management (Biological Sciences 562).

Insect Physiology

483 Insect Physiology (Lectures). Fall term. Credit three hours. Open to seniors in entomology and graduate students. No prerequisite but courses in biochemistry, physics, and animal physiology are recommended. M W F 9:05. Comstock 145. Mr. Patton.
An introductory course in the physiology of insects. Primarily for graduate students in entomology, or physiology majors.

484 Insect Physiology (Laboratory). Fall term. Credit two hours. Laboratories, M W 2–4:25. Caldwell 294. Mr. Patton.
A laboratory course to accompany Insect Physiology Lectures. Should be taken in conjunction with Insect Physiology Lectures.

Insect Toxicology and Insecticidal Chemistry

590 Insect Toxicology and Insecticidal Chemistry. Spring term. Credit four hours. Given in alternate years. Prerequisite: general chemistry and organic chemistry. Undergraduate students by permission. Lectures, M W F 8. Comstock 145. Laboratory, day to be arranged, 1:25–4:25. Caldwell 294. Mr. Wilkinson.
The chemistry of insecticides and their metabolism and mode of action in insects and mammals.

591 Analysis of Pesticide Residues. Spring term. Credit one hour. Given in alternate years. Prerequisite: general chemistry and organic chemistry. Undergraduate students by permission. To be offered next Spring, 1973. Time and place to be arranged. Mr. Lisk.
Analytical techniques in extraction, isolation, and determination of pesticide residues.

592 Introductory Insecticide Chemistry. Fall term. Credit two hours. Prerequisite: permission to register. Time and place to be arranged. Mr. Young and Mr. Wilkinson.
A brief consideration of selected physical and chemical concepts of importance in insecticidal chemistry and biochemistry.

Research or Special Topics

Fall and spring terms. Credit to be arranged. Prerequisite: permission to register. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade.

510 Ecology. Messrs. Berg, Feeny, Gyrisco, Helgesen, Pimentel, Root, and Tauber.

511 Biological Control. Messrs. Berg, Gyrisco, Kramer, Pimentel, and Tauber.

512 Insect Behavior. Messrs. Eickwort and Tauber.

515 Insect Pathology. Mr. Kramer.

520 Morphology. Mr. Eickwort.

530 Taxonomy. Messrs. Brown, Eickwort, Franclemont, Keeton, and Pechuman.

540 Economic Entomology. Messrs. Brann, Dewey, Gyrisco, Helgesen, Johnson, Matthysse, Muka, Pechuman, Pimentel, Raffensperger, Saunders, Semel, and Tauber.

550 Medical Entomology and Parasitology. Messrs. Kramer and Raffensperger.

564 Apiculture. Mr. Morse.

570 Aquatic Entomology. Messrs. Berg and Pimentel.

585 Insect Biochemistry. Messrs. Patton, Young, and Wilkinson.

586 Insect Biochemistry. Messrs. Young and Wilkinson.

596 Toxicology and Chemistry of Insecticides. Messrs. Dewey, Lisk, O'Brien, Young, and Wilkinson.

Seminar

Jugatae. Fall and spring terms. M 4:00–5:00. Comstock 245.
An entomological seminar is conducted by Jugatae, the entomological club of Cornell University, to discuss topics of interest to its members and guests.

Floriculture and Ornamental Horticulture

Instruction in the Department of Floriculture and Ornamental Horticulture is planned for students with the following interests: (1) commercial plant production, distribution, or utilization, including the management of greenhouses, nurseries, and wholesale and retail establishments; (2) developing a landscape service, including the planning, construction, planting, and maintenance of small properties; (3) superintendence of parks, golf courses, cemeteries, arboretums, or garden centers; (4) the culture and use of ornamental plants in the home garden and in the home; (5) turfgrass production and management; (6) scientific research and teaching; (7) landscape architecture.

Special curricula are set up to meet the needs of those students desiring training in the fields listed above.

Undergraduate students may plan their courses as preparation for graduate training leading to university teaching or research positions with universities, experiment stations, or industry.

Courses 100, 210, 213, 312, 401–402, Landscape Architecture 103, Biological Sciences 242 or 340, Agronomy 200, and Plant Pathology 301 provide a core of courses basic and fundamental to the general knowledge of floriculture and ornamental horticulture, regardless of area of specialization, and should be taken by all departmental students, except those in the landscape specialization, which has other requirements.

General Courses

General Horticulture (Vegetable Crops 103).

Introduction to Landscape Design (Landscape Architecture 102).

100 Introductory Floriculture and Ornamental Horticulture. Fall term. Credit three hours. S-U grades optional for students not specializing in floriculture. Lecture: T Th 10:10. Plant Science 37. Laboratory, T 2–4:25. Plant Science 37 or Kenneth Post Laboratory. Mr. Boodley.
An introduction to the opportunities and scope of the field and the Department of Floriculture and Ornamental Horticulture at Cornell. A rationale for information that will be obtained in subsequent courses taken in the Department and the College to develop student awareness of the vital impact ornamental horticulture in its broadest sense has on everyday life. A required field trip to visit various commercial enterprises is made and costs approximately $15 plus room and meals.

105 Principles of Flower Arrangement. Fall or spring term. Credit two hours. Enrollment limited to 18 students for each laboratory section. Fall term. Lecture, Th 9:05. Plant Science 37. Laboratory, W or Th 2–4:25 or Th 10:10–12:35. Plant Science 22. Mr. Fox. Spring term. Lecture, T 10:10. Plant Science 37. Laboratory, T W Th 2–4:25. Plant Science 22. Mr. Fischer.
A study of the care and handling of flowers, the factors affecting keeping quality, and the design principles involved in the use of flowers and related decorative materials.

401–402 Physiology of Horticultural Plants. Fall and spring terms. Prerequisite: Biological Sciences 242 or 340 or permission of the instructor. Fall term: credit three hours; lecture, T Th 8, Plant Science 37; laboratory, Th 2–4:25, greenhouses. Mr. Tukey. Spring term: Credit four hours; lecture, M W F 8. Plant Science 141. Laboratory, M 2–4:25; Plant Science 37 and greenhouse. Mr. Steponkus.
Fall term. Application of physiology to germination of seeds, rooting of cuttings, manipulation of bulbs, and propagation of plants by budding and grafting, stressing basic mechanisms concerning initiation and development of roots and shoots.

Spring term. A study of the physiology of growth and development of horticultural plants in response to their environment.

Plant Materials

210 Taxonomy of Cultivated Plants. Fall term. Credit four hours. Intended primarily for departmental majors. Prerequisite: Biological Sciences 103–104 or its equivalent. Lecture, M W 10:10. Plant Science 37. Laboratory, M W 2–4:25. Plant Science 29. Mr. Ingram.
A study of the kinds of cultivated ferns and seed plants and their classification into families and genera. Emphasis is placed on methods of identification, the preparation and use of the analytical keys, the distinguishing characteristics of the families concerned, and their importance in ornamental horticulture.

213 Woody-Plant Materials. Spring term. Credit four hours. Prerequisite: 210 or permission to register. Lectures, T Th 9:05. Laboratory, T W or F 2–4:25. Plant Science 29. Mr. Mower.
A study of the trees, shrubs, and vines used in landscape planting. Emphasis is placed on their identification and values for use as landscape material. The class visits Rochester parks and gardens. Cost: $5 plus one meal.

312 Herbaceous Plant Materials. Fall term. Credit three hours. Prerequisite: course 210 or permission to register. Lecture, T Th 10:10. Laboratory, T 2–4:25. Plant Science 29. Mr. Mower.
A study of the ornamental herbaceous plants used in landscape and garden plantings. Emphasis is placed on the identification, use, and culture of bulbs, annuals, and perennials.

313 Woody-Plant Materials. Advanced Course. Fall term. Credit two hours. Limit 30 students. Prerequisite: 213. F 1:25–4:25. Plant Science 29. Mr. Mower.
The important groups of landscape materials and the literature of the subject. A knowledge of the ordinary woody plants for landscape use in the Northeast is presumed. Emphasis is on lesser-known northern plants and upon plant groups basic in landscape design in other regions of the United States. Opportunities for practice in the determination of unknowns and in the use of the literature are provided. A trip is taken to Washington, D.C., and vicinity. Cost: $15 plus room and meals.

Nursery Management

314 Turfgrass Management. Spring term. Credit two hours. Prerequisite: Agronomy 200 or permission to register. Lecture, Th 11:15. Plant Science 141. Laboratory, Th 2–4:25. Plant Science 15. Mr. Cornman.
The principles, practices, and materials for the construction and maintenance of lawn, sports, and utility turfgrass areas.

317 Nursery Crop Production and Maintenance. Fall term. Credit four hours. Prerequisite: 401. Lectures, M W F 9. Plant Science 37. Laboratory, M 2–4:25. Greenhouses and nursery. Mr. Good.
The problems of commercial propagation and growing of nursery plants to marketable stage. Digging, storage, and packaging of nursery stock are included. Consideration is given to the planting and culture of landscape plants. Some aspects of garden center management are stressed. Field problems and observational trips are included in laboratory work. Field trips cost $15 plus room and meals.

318 Advanced Turfgrass Management. Fall term. Credit two hours. Prerequisite: 314 or the equivalent. Lecture, M 10:10. Plant Science 141. Laboratory, M 2–4:25. Plant Science 22. Mr. Cornman.
A continuation of course 314, with emphasis on the application of basic principles to problems of such large-scale operations as landscape maintenance and the execution and maintenance of golf courses, athletic fields, industrial grounds, and nursery sod production. A weekend inspection trip is taken to experimental test plots and special turf areas. Cost $10 plus room and meals.

Commercial Floriculture

325 Flower-Store Management. Fall term. Credit three hours. Prerequisite: 105 and permission to register. Lectures, Place and two hours to be arranged. Laboratory, T 2–4:25. Plant Science 22. Mr. Fox.
Lectures devoted to flower-shop management, business methods, merchandising, and marketing of floricultural commodities. Laboratories to include the application of subject matter and the principles of commercial floral arrangement and design. A required four-day weekend field trip is made to flower shows and to wholesale and retail florist establishments. Cost: $10 plus room and meals.

[424 Florist Crop Production. Spring term. Credit four hours. Prerequisite: 401–402 (may be taken concurrently) or permission of the instructor. Given in alternate years. Lectures, M W F 9:05. Plant Science 37. Laboratory, M 2–4:25. Greenhouses. Mr. Seeley. Not given 1972–73.
The commercial production of florist crops. Emphasis is on culture of plants as influenced by greenhouse environment. Field trips are made to commercial greenhouses. Cost $15 plus room and meals.]

425 Greenhouse Production Management. Spring term. Credit three hours. Given in alternate years. Prerequisite: an elementary

course in horticulture or equivalent. Lectures, M W 9:05. Plant Science 37. Laboratory, W 2–4:25. Kenneth Post Laboratory. Mr. Langhans.
Intended to provide the latest information relative to efficient operation and administration of a commercial greenhouse range outside the sphere of actual production methods for specific crops. Consideration is given to the industry and centers of production and competition, location of the greenhouse range, types of structures, heating and ventilation, plant containers, soils and fertilizers, photoperiod control, and harvesting and postharvest handling of floriculture crops. Field trips will be taken. Cost $15 plus room and meals.

Department Seminars

450 Special Topics in Floriculture and Ornamental Horticulture. Fall and spring terms. Hours and credit to be arranged. Written permission of staff member is required to register. Primarily for upperclass and graduate students. Mr. Mower.
Topical subjects in plant materials. Independent and group study of important groups of plant materials and of situations that affect their successful use in planting programs. The topics will be announced each year in the supplementary announcement.

550 Special Problems in Floriculture and Ornamental Horticulture. Fall or spring term. Credit one or more hours. S-U grades optional. Prerequisite: adequate training for the work. Undergraduates must attach to their preregistration material written permission from the staff member who will supervise the work and assign the grade. Mr. J. W. Boodley and staff.
Special work on problems under investigation by the department or of special interest to the student, provided adequate facilities are available. Students must satisfy the staff member under whom the work is to be taken that their preparation warrants their choice of problems.

600 Seminar. Fall and spring terms. S-U grades only. For departmental staff and graduate students. Th 4:30. Plant Science 37.

Introduction to Landscape Architecture (Landscape Architecture 102).

Elementary Landscape Architectural Design (Landscape Architecture 103).

Intermediate Landscape Architectural Design (Landscape Architecture 232).

Planting Design (Landscape Architecture 332).

Junior Landscape Architectural Design (Landscape Architecture 333).

Landscape Construction (Landscape Architecture 341–342).

Senior Landscape Architectural Design (Landscape Architecture 434–435).

Recreational Planning (Landscape Architecture 436).

Professional Practice and Ethics (Landscape Architecture 451).

Special Problems in Landscape Architecture (Landscape Architecture 555).

Landscape Architecture

The Department of Floriculture and Ornamental Horticulture through its Landscape Architecture Division offers a four-year curriculum in landscape architecture. The student is trained in the use of land, water, and plant and structural forms for efficient, safe, and pleasant use. He learns how to collaborate with the other planning professions. In addition to general and technical courses taught in the classroom, the student makes supervised inspection trips to view examples of professional landscape architecture and, also, is required to obtain a specified amount of approved practical experience during the summer months. The curriculum leads to the Bachelor of Science degree with a specialization in landscape architecture.

102 Introduction to Landscape Architecture. Fall or spring term. Credit three hours. Lectures. Fall term, M W F 9:05. Mr. Adleman and Mr. Dwelle. Spring term, M W F 9:05. Mr. Adleman and Mr. Dwelle. East Roberts 222.
A consideration of the principles of landscape architecture as applied to present day planning. Intended primarily for nondepartmental majors.

103 Elementary Landscape Architectural Design. Fall term. Credit four hours. Lecture: T 11:15. Laboratories, M W F 10:10–12:35. Five hours must be scheduled in the laboratory time specified above with an additional 2½ hours as arranged. Intended primarily for department majors. Plant Science 433. Mr. Scannell.
Principles of design, with practice in the use of drawing instruments and graphic interpretation of ideas.

232 Intermediate Landscape Architectural Design. Spring term. Credit three hours. Prerequisite: 103, 213, 312, and one course in freehand drawing. Lecture, M 11:15. Laboratories, T Th 10:10–12:35. Plant Science 433. Mr. Adleman.
The application of the principles of design to the specific problems of the small residential property as well as other small-scale landscape architectural problems. A terminal course for those not intending to major in this field.

332 Planting Design. Fall term. Credit three

hours. Prerequisite: 232. Lecture, W 12:20. Laboratories, W F 2–4:25. Plant Science 433. Mr. Dwelle.
An advanced course in design with emphasis on plant combinations and uses in association with structure and gardens. Practice in drawing and estimating planting plans.

333 Junior Landscape Architectural Design. Spring term. Credit four hours. Prerequisite: 232. Lecture, M 12:20. Laboratories, M W F 2–4:25. Plant Science 433. Mr. Scannell.
Practice in making landscape architectural plans for actual situations is an essential part of this course. Industrial and commercial landscape architectural treatments are included.

341–342 Landscape Construction. Throughout the year. Credit four hours a term. Prerequisite: Civil Engineering 2452. Fall term is prerequisite to spring term. Fall term, Lectures, M W 10:10. Laboratories, T Th 9:05–11:30. Spring term, Lectures, M W 8:00. Laboratories, T Th 8:00–10:30. Plant Science 428. Mr. Adleman.
Theory and drafting room practice in interpretation and preparation of grading, detailed construction drawings, and small structural design; study of highway and road alignment, and landscape hydraulics. Emphasis on surveying applications, earthwork, drainage and structural systems, materials, engineering mathematics, material take-offs, and cost analysis.

434–435 Senior Landscape Architectural Design. Throughout the year. Credit four hours a term. Prerequisite: 333. Fall term is prerequisite to spring term. Lecture, W 1:00. Laboratories, M W Th 2–4:25. Plant Science 433. Mr. Adleman and Mr. Scannell.
A succession of landscape architectural problems of an increased degree of complexity. Included will be problems involved in the design of institutions, resort areas, industrial complexes, and other similar areas.

436 Recreational Planning. Spring term. Credit three hours. Prerequisite: 333. One lecture and two laboratories. Lecture, T 12:20. Laboratories, T F 2–4:25. Plant Science 433. Mr. Scannell.
Theory of recreational planning and design with a study of the design, construction details, and other working drawings for recreational areas of all sizes.

451 Professional Practice and Ethics. Fall term. Credit two hours. Prerequisite: 342. Lecture, T 1:00. Laboratory, T 2–4:25. Plant Science 433. Mr. Adleman.
An extensive coverage of methods used in the professional practice of landscape architecture together with approved office procedure. Problems inherent with office practice and solutions to these problems will be covered.

555 Special Problems in Landscape Architecture. Fall or spring term. Credit one or more hours. Prerequisite: adequate training for the work, and permission of the staff member who will supervise the work. Staff.
Special work on problems of interest to the student.

Freehand Drawing and Illustration

109–110 Drawing for Landscape Students. Throughout the year. Credit three hours a term. Credit may not be received for both course 109 and 111. S-U grades optional for graduate students only. Fall term is prerequisite to spring term. Intended primarily for departmental majors. Others may register in the fall, if space permits, with permission of instructor. Fall term, M W F 11:15–1:25. Spring term, M W F 11:15–1:10. Mann 500. Mrs. Elliot and Mr. Lambert.
Planned to develop practical ability in the sketching of outdoor planting and landscape features, facility in lettering, and knowledge of isometric and perspective construction from plans and elevations. Sketchbook assignments, to be done outside class, are given throughout the year.

111 Freehand Drawing. Fall or spring term. Credit three hours. Credit may not be received for both 109 and 111. Prerequisite: permission of instructor to register. S-U grades optional for graduate students only. Lecture: Fall term, W 10:10; Spring term, T or W 10:10. Six hours of time, including the lecture period, are to be spent in the drawing room preferably in two-hour units. These hours must be scheduled between 9:05 and 11:15 M W F in the fall term, and between 9:05 and 12:05 M T W Th F or T 2–4:25 in the spring term. Mann 500. Mrs. Elliot and Mr. Lambert.
The objective is to develop accuracy of observation and skill in delineation. Practice is given in outdoor sketching and in the drawing of still-life set-ups, interior scenes, and human figures. The principles of freehand perspective are taught and applied. The course is designed to aid those who plan to work in nature study, biological sciences, and home economics. Sketchbook assignments to be done outside class are given throughout the year.

211 Freehand Drawing and Illustration. Fall term. Credit two hours. S-U grades optional for graduate students only. Prerequisite: Drawing 111 or the equivalent. Six hours of time, including one lecture period arranged during the first week, are to be spent in the drawing room, preferably in two hour units. These hours should be scheduled between 9:05 and 12:05 M T W Th F. Mann 500. Mr. Lambert.
This course carries on from the object draw-

ing of the beginning course to the organization of a complete illustration. The subject matter is derived largely from quick, on-the-spot sketches. Composition, perspective relationships, and ways of rendering are all considered. The work is planned primarily to help students who expect to use their sketching ability in landscape work, interior decorating, or the illustrating of their own papers, bulletins, and books.

214 Water Color Illustration. Spring term. Credit two hours. Prerequisite: 111 or the equivalent. S-U grades optional for graduate students only. Six hours of practice must be scheduled, preferably in two hour units, between 9:05 and 12:05 M T W Th F or T 2–4. Mann 500. Mr. Lambert.
The student learns to mix colors, lay washes, and plan the values of his composition before he tries illustration in color.

316 Advanced Drawing. Fall or spring term. Credit two hours. S-U grades optional. Three hours of practice required for each hour of credit. Prerequisite: 110, 312, or the equivalent. Time to be arranged. Mann 500. Mrs. Elliot and Mr. Lambert.
For students who wish to attain proficiency in some particular type of illustration or technique.

417 Scientific Illustration. Fall term. Credit two hours. S-U grades optional. Prerequisite: 211 or permission of the instructor. Six hours of practice to be scheduled, preferably in two-hour units. These hours may be scheduled between 9:05 and 12:05 M T W Th F. Warren 500. Mrs. Elliot.
A survey of illustration methods suitable for various scientific fields; training in the techniques of pen and ink, scratch board, stipple board, wash, and color overlays. Instruction in the use of the camera lucida, pantograph, projectoscope, and other time-saving methods of getting accurate results as quickly as possible. Methods of reproducing illustrations are studied in relation to problems of publication.

Food Science

The Department of Food Science offers a curriculum leading to a Bachelor of Science degree with a specialization in food science. The curriculum includes a core of basic courses plus electives chosen to meet the specialized interest of the student. Elective courses can be chosen in chemical, physical, or engineering sciences for those planning careers in research or teaching; or in business and accounting for those interested in managerial work.

Students interested in managerial work can combine a regular four-year program with a graduate program by qualifying for the combination program in the Cornell Graduate School of Business and Public Administration. This is a five-year program which permits the student to obtain a Bachelor of Science degree at the end of the senior year and a Master of Business Administration at the end of the fifth year. The curriculum also provides opportunity for the science-minded student to prepare for graduate work in food science.

100 Introductory Food Science. Fall term. Credit three hours. M W F 10:10. Stocking 204. Mr. Potter.
A survey course intended to expose the student to the broad field of food science and technology, its scope, principles, and practices. Lectures will deal with the constituent properties of foods, methods of food preservation, the major food groups, including their handling and processing, and current problems such as chemical additives and world feeding needs. Throughout the course the interrelationships between sanitation, processing, nutrition, and food quality will be stressed.

150 Food Facts and Fads. (S and U optional). Spring term. Credit two hours. Evening lectures, T 7:30. Discussion periods (one hour) to be arranged. Staff and invited speakers. Mr. Shipe in charge.
A series of public lectures dealing with current topics relating to foods. Attempts will be made to dispel misconceptions about food properties and the factors affecting them. Lectures are open to students and the public. Students taking the course for credit will participate in weekly discussions dealing with the lecture material.

200 Food Chemistry I. Fall term. Credit two hours. Prerequisite: General Chemistry. T Th 9:05. Stocking 120. Mr. Kinsella.
This course deals with the basic structure and properties of the chemical components of foods. The involvement of specific functional groups and their interactions in influencing the quality attributes of foods are discussed.

210 Food Analysis. Spring term. Credit two hours. Prerequisite: Chemistry 104 or 108. Lecture, F 12:20. Stocking 120. Laboratory, F 1:25–4:25. Stocking 209. Mr. Ledford and assistants.
Designed to acquaint the student with a variety of chemical and bacteriological tests used by food analysts.

300 Physical Chemistry of Foods I. Fall term. Credit two hours. Lecture M W 11:15. Stocking 119. Given in alternate years. Mr. Sherbon.
The application of physiochemical principles to the understanding of complex behavior of food systems and biological materials. Study of the principles involved in the behavior of

emulsions and colloidal suspensions. The properties of solutions, reaction rates, electrolytic dissociations, hydrogen ion concentration, oxidation reduction potential, photochemistry, and introduction to energy relationships.

301 Nutritional Aspects of Raw and Processed Foods. Fall term. Credit three hours. M W F 9:05. Stocking 119. Given in alternate years. Mr. Graham.
This course deals with those principles that relate processing procedures to the nutritional value of foods.

302 Introduction to Food Engineering. Fall term. Credit four hours. Given in alternate years. Prerequisites: 100 and a course in physics. Lectures, M W F 10:10. Laboratory, M 2–4:25. Stocking 119. Mr. Jordan.
Engineering aspects of dairy and food plant operations.

304 Sanitary Principles, Toxicology, and Public Health. Fall term. Credit three hours. Given in alternate years. Prerequisite: F.S. 100. Lectures, T Th 12:20. Stocking 120. Laboratory, T 1:25–4:25. Mr. White.
Biological and chemical control of food contamination and processing. U.S. Public Health Service, USDA, FDA, and other requirements for production, protection, and processing of foods. Quality assurance in foods.

400 Research. Fall or spring term. Credit two hours. Credit will be allowed for one term only except for students enrolled in the Honors Program. Undergraduates must attach to their preregistration material written permission from the staff member who will supervise the work and assign the grade. Staff.

[402 Concepts of Product Development. Spring term. Credit two hours. Given in alternate years. Prerequisite: F.S. 100 or equivalent. M W 10:10. Stocking 120. Mr. Hood. Not given 1972–73.
A discussion of the sequence of events involved in the development and marketing of food products. Topics will include packaging and labeling, legal and functional ingredient restrictions, taste panel and in-store testing, patents, and pricing.]

[402A Product Development Laboratory. Spring term. Credit one hour. One extra hour may be arranged in special cases by written permission from the instructor prior to registration. Given in alternate years. Time to be arranged. Riley-Robb 44. Mr. Hood and assistants. Not offered 1972–73.
A laboratory to be taken concurrently with F.S. 402. Emphasis will be on gaining practical experience in the formulation and processing of new foods.]

[403 International Food Development. Fall term. Credit three hours. Given in alternate years. M W 2–4:25. Stocking 119. Mr. Kosikowski. Not offered 1972–73.
A study of programs, technical problems and progress associated with developing, processing and marketing acceptable foods throughout the world. Attention will be given to expanding protein resources for man in critical areas. International aspects of pollution and public health related to food are considered. Special attention is given to the organization, operations, relationships, and contributions of UN technical agencies, FAO, UNICEF, WHO, and governmental and nongovernmental organizations in the field.]

[404 Food Processing I—Drying, Freezing, Heat Preservation. Spring term. Credit three hours. Given in alternate years. Lectures, T Th 11:15. Stocking 119. Laboratory, T 1:25–4:25. Mr. Potter. Not offered 1972–73.
Deals with the principles and practices of drying, freezing, canning, and other heat treatments applied to foods. Current processing methods will be considered as related to the chemistry, microbiology, and technology of the ingredients and final products.]

405 Food Processing II—Concentrating, Separating, Mixing. Spring term. Credit three hours. Given in alternate years. Lectures, T Th 11:15. Stocking 119. Laboratory, 1:25–4:25. Mr. Jordan.
Deals with the principles and practices of evaporation reverse osmosis, homogenization, size reduction and other unit operations important to the food industry.

[406 Food Processing III—Fermentations. Fall term. Credit four hours. Given in alternate years. Prerequisite: a beginning course in biology, microbiology, or biochemistry is recommended. Lectures (discussions and demonstrations), T Th 11:15–4:25. Stocking 120. Mr. Ledford and Mr. Kosikowski. Not offered 1972–73.
Principles and processes leading to important foods such as fermented milks, yogurt, cheese, wines, and beers. Consideration is also given to other fermentations resulting in foods from plant, animal and enzyme sources. Practices designed to acquaint students with fermentation and enology principles and with the physical and sensory qualities of the above foods are carried out by demonstration and through field trips.]

[407 Food Processing IV—Fats and Oils. Fall term. Credit three hours. Given in alternate years. Open to upperclassmen and graduate students. Lecture demonstrations, W F 9:05. Stocking 120. Laboratory practice, F 1:25–4:25. Stocking 119. Mr. Kinsella.
The sources, composition, and properties of edible fats and oils are discussed. All classes of lipids are considered, and their effects on food quality and storage stability are described. Factors affecting the chemical and physical stability of food fats are enumerated.

The chemical technology of emulsifiers, shortenings, edible oils, margarine, and butter is described.]

410A Food Chemistry II. Spring term. Credit two hours. Prerequisites: F.S. 200 or Organic Chemistry. Concurrent registration in 410B recommended. Lecture, T Th 9:05. Stocking 119. Mr. Shipe.
Deals with the effect of chemical composition on the properties of foods. Special attention will be given to the factors affecting variation in composition and the consequent changes in flavor, color, and texture.

410B Sensory and Objective Evaluations of Foods. Spring term. Credit two hours. Prerequisite: Statistics. Concurrent registration in 410A recommended. Lecture, Th 12:20. Stocking 119. Laboratory, Th 2:00–4:25. Mr. Shipe.
Deals with sensory techniques used to evaluate the flavor, color, and texture of foods and the effect of these properties on consumer acceptance. Objective methods for measuring these qualities will be discussed and demonstrated.

[411 Food Mycology. Fall term. Credit three hours. Given in alternate years. Prerequisite: Microbiology 290A, 290B or equivalent. Microbiology 394 is recommended. M W F 10:10. Stocking 120. Mr. Graham. Not offered 1972–73.
The purpose of this course is to acquaint students with those groups of fungi that are important, both from the standpoint of their beneficial as well as their harmful effects, in food production, preservation, and spoilage. Further, the intent is to give the student some appreciation of the use of fungi as food.]

[412 Aquatic Microbiology. Spring term. Credit three hours. Given in alternate years. Prerequisite: introductory bacteriology (Biological Sciences 290 or equivalent, or Soil Science 306). M W F 10:10. Stocking 120. Mr. Dondero. Not offered 1972–73.
A consideration of the relation of microorganisms, especially the bacteria, to aquatic environments, both natural and artificial. The microbiology of waste waters will be included. Attention will be given to fundamental biological concepts and to applied aspects of the occurrence and activities of microorganisms in water.]

499 Food Industry Management Topics. Fall term. Credit two hours. Open to seniors and graduate students. Lecture and Laboratory, F 1:25–4:25. Stocking 124. Mr. Bandler.
A summary of concepts and techniques useful to Food Science majors in the areas of communication and interpersonal relationships in business. Deals primarily with oral, written, and visual presentation of scientific data, basic office procedures, business practices, and resumé preparation. Stress will be on practical use of the material presented.

[501 Protein and Food Enzymes. Fall term. Credit three hours. Given in alternate years. Open to graduate students. M W F 12:20. Stocking 119. Mr. Vadehra. Not offered 1972–73.
The first part of the course deals with the general properties of proteins: structure, preparation, and reactions. The second part deals with proteins as part of food systems, occurrence and composition, associations and structures, and reactions to processing. The use and application of enzymes in the food industry will be discussed.]

502 Food Lipids. Fall term. Credit two hours. Given in alternate years. Open to graduate students. W F 12:20. Stocking 119. Mr. Kinsella.
Covers the disposition of lipid materials in foods and the manner in which lipids influence the chemical and physical attributes of various foods. The effects of production techniques, storage, heating, refrigeration, and enzymes on food lipids are described and the chemical mechanisms involved in oxidation are elucidated. The importance of lipids in the formation of food flavors is discussed.

[503 Food Carbohydrates. Spring term. Credit two hours. Given in alternate years. Open to qualified seniors and graduate students. Prerequisite: Biological Science 431 or equivalent. T Th 10:10. Stocking 120. Mr. Hood. Not offered in 1972–73.
A consideration of the chemistry of carbohydrates in foods including sugars, starches, pectins, gums, and cellulose. Emphasis will be placed on their origin in raw materials and the subsequent changes occurring during processing and storage.]

504 Chemistry of Dairy Products. Fall term. Credit two hours. Given in alternate years. Prerequisites: qualitative and quantitative analysis and organic chemistry. Hours by arrangement. Stocking 120. Mr. Ledford.
A study of milk constituents and physical properties. Deals with milk enzymes, lactose, milk fat, milk proteins, and minor constituents.

505 Physical Chemistry of Foods II. Spring term. Credit two hours. Lecture, M W 10:10. Stocking 119. Given in alternate years. Mr. Sherbon.
The physical chemical principles of important food systems with special emphasis on colloids and emulsions. Reaction kinetics, thermodynamics, and molecular interactions will also be considered.

506 Instrumental Methods. Spring term. Credit five hours. Prerequisite: permission of the instructor. Lecture, M W F 11:15. Stocking 120. Laboratory, M or T 1:25–4:55. Stocking

209. Mr. Sherbon.
Deals with instrumental methods widely used in research and industry. The major emphasis is on chromatography, spectroscopy, electrophoresis, ultracentrifugation, thermal analysis, and the use of computers. The stress will be on the practical use of the material presented.

[**507 High-Protein Food Technology.** Fall term. Credit two hours. Given in alternate years. Designed for graduate student majors in International Food Development but open to other qualified students. Recommended: Food Science 403 or equivalent. F 10:10–12:05. Stocking 124. Other hours by arrangement. Mr. Kosikowski. Not offered 1972–73. The needs, types, processing techniques, nutritional qualities, and economics of high-protein foods for an expanding world population are examined in discussions and through individual study. Basic protein foods from cereals, pulses, oil seeds, milk, and marine life will be considered along with single-cell protein foods from whey, cellulose, leaves, and petroleum.]

508 Food Color and Food Pigments. Spring term. Credit one hour. Lecture, F 11:15. Stocking 119. Given in alternate years. Mr. Van Buren.
An introduction to theories of color perception and color spaces is followed by a survey of chemical and physical properties of the major food pigments and their stability during processing and storage. Compounds will be compared for color contributions and other functional properties. Color and pigments of selected commodities will be examined in detail.

509 Rheology. Spring term. Credit one hour. Lecture, F 10:10. Stocking 119. Given in alternate years. Mr. Bourne.
The course deals with the fundamental concepts of rheology as applied to foods with emphasis on objective methods for measuring physical properties of foods. It covers the principles and practice involved in measuring of solid foods, viscosity of liquid foods, and consistency of semisolid foods, instrumentation, and correlations between objective and sensory methods of texture measurements. Examples of rheological problems in each major food group are discussed.

510 Chemical Toxicology. Spring term. Credit two hours. Lecture, F 1:25–3:20. Stocking 119. Given in alternate years. Mr. Stoewsand.
Discussions on concepts of toxicology; physiologic active substances in foods, intentional and unintentional food additives; and safety evaluation of foods. Assigned writing or student lecture will widen knowledge of current research in the area.

599 Preparation for Food Science Teaching. Fall and spring terms. Open to qualified Food Science graduate students not already serving as teaching assistants. Department Head and staff.
Designed to give graduate students some experience in teaching and in the preparation of courses. Participants will assist professor in regular Food Science courses, including some actual teaching experience, and will be required to attend a number of orientation lectures on teaching techniques.

600 Seminar. Fall and spring terms. Required of all food science graduate students.

Applied and Industrial Microbiology (Biological Sciences 393).

Dairy and Food Microbiology (Biological Sciences 394).

Meat and Meat Products (Animal Science 290).

Meat Cutting (Animal Science 293).

Science and Technology of Meat, Fish and Eggs (Animal Science 490).

Postharvest Handling and Marketing of Vegetables (Vegetable Crops 312).

Marketing (Agricultural Economics 240).

International Agriculture

600 Seminar: International Agricultural Development. Fall and spring terms. No credit. Third and fourth Wednesdays of each month, 4:30–5:30. Emerson 135. Mr. Turk and staff.
Primarily for graduate students interested in an integrated view of problems related to international agricultural development. Undergraduates with a specialization in international agriculture are encouraged to attend without registering. The seminar will focus on developing an understanding of the nature and interrelatedness to agricultural development of the social sciences, plant and animal sciences, foods and nutrition, and natural resources.

601 Philippine Agricultural Development: Policy and Administration. Spring term. Credit two hours. Th 3:35. Ives 214. Mr. Golay and Mr. Levine.
Major aspects of Philippine agricultural development will be considered from economic, social, and technological points of view.

Economics of Agricultural Geography (Agricultural Economics 150).

Regional Agricultural Studies (Agricultural Economics 452).

Economics of Agricultural Development (Agricultural Economics 464).

World Food Population and Employment (Agricultural Economics 560).

Seminar on Agricultural Policy (Agricultural Economics 651).

Seminar on Latin American Agricultural Policy (Agricultural Economics 665).

Seminar in the Economics of Agricultural Development (Agricultural Economics 668).

Seminar in Agriculture and Economic Planning Models (Agricultural Economics 669).

Identification, Appraisal, and Geography of Soils (Agronomy 301).

Tropical Meteorology (Agronomy 331).

Geography and Appraisal of Soils of the Tropics (Agronomy 401).

Soil Mineralogy (Agronomy 405).

Tropical Agriculture (Agronomy 422).

Special Studies in Soils of the Tropics (Agronomy 481).

Grasslands and Grassland Research (Agronomy 514).

Special Studies in Tropical Agriculture (Agronomy 522).

Livestock Production in Warm Climates (Animal Science 400).

Special Studies on Problems of Livestock Production in the Tropics (Animal Science 401).

Forages of the Tropics for Livestock Production (Animal Science 403).

International Communication (Communication Arts 501).

Communication in the Developing Nations (Communication Arts 524).

Comparative Mass Media (Communication Arts 526).

International Natural Resources (Conservation 511).

Designing Developmental Change Programs (Education 524).

Educational Communication (Education 525).

Advanced Methods and Materials of Teaching Agriculture (Education 532).

Seminar on Comparative Systems of Extension and Adult Education (Education 627).

International Food Development (Food Science 403).

High Protein Food Technology (Food Science 507).

International Nutrition Problems, Policies, and Programs.
See the *Announcement of the Graduate School of Nutrition.*

International Crop Breeding and Improvement (Plant Breeding 506).

Plant Diseases in Tropical Agricultural Development (Plant Pathology 655).

Economic Fruits of the World (Pomology 301).

Community and Regional Development and Planned Change (Rural Sociology 411).

Rural Society (Rural Sociology 412).

Comparative Rural Societies (Rural Sociology 420).

Occupations and Social Issues (Rural Sociology 424).

Cross-Cultural Research Methods (Rural Sociology 516).

Applications of Sociology to Development Programs (Rural Sociology 528).

Seminar, Contemporary Social Theory II (Rural Sociology 631).

Seminar in Social Change and Development (Rural Sociology 636).

Special Topics in Plant Science Extension (Vegetable Crops 429).

Research Methods in Applied Plant Science (Vegetable Crops 501).

Meteorology

201 Basic Principles of Meteorology. Fall term. Credit three hours. Lectures, T Th 11:15. Bradfield 101. Laboratory, T W or Th 2–4:25. Bradfield 1102. Mr. Dethier.
Simplified treatment of structure of the atmosphere; heat balance of the earth; general and secondary circulations; air masses, fronts, and cyclones; hurricanes; thunderstorms, tornadoes, and atmospheric condensation. In the laboratory, emphasis is on techniques of analysis of weather systems.

201A Basic Principles of Meteorology (Laboratory). Fall term. Credit one hour. Prerequisite: Introductory course in Meteorology without a laboratory. T W Th 2–4:25. Bradfield 1102. Mr. Dethier.
Techniques of analysis of weather systems and the application of dynamical and empirical methods of prediction of the daily atmospheric circulation.

202 Dynamic Climatology. Spring term. Credit three hours. Prerequisite: 201. M W F 11:15. Bradfield 108. Mr. Dethier.
The first part of the course is devoted to the description of world climates in terms of the global distribution of radiation, temperature, pressure, and wind; precipitation and air masses. The second part of the course relates climates and climatic anomalies to planetary, regional, and local circulations.

327 Meteorological Communications Spring term. Credit one hour. Primarily for under-

graduate meteorology majors. Time to be arranged. Staff.
This course will acquaint the student with facsimile, teletype, and satellite receiving equipment and the data products used in weather forecasting.

[331 Tropical Meteorology. Spring term. Credit three hours. Given in alternate years. Prerequisite: course 201 or 411. M W F 9:05. Bradfield 105. Mr. D. Paine. Not given in 1972–73.
A study of the general circulation of the tropics, easterly waves, hurricanes, monsoons, and local diurnal tropical weather phenomena.]

411–412 Theoretical Meteorology I and II. Fall and spring terms. Credit three hours. Prerequisite: one year each of calculus and physics. Course 411 is prerequisite to course 412, unless special permission is obtained from the instructor. M W F 10:10. Bradfield 1102. Mr. Knapp.
Topics covered in the fall semester include thermodynamics of dry air; water vapor and moist air; atmospheric hydrostatics and stability. The spring term includes a review of vector operations and fundamentals of fluid mechanics; meteorological coordinate systems; variation of wind and pressure fields in the vertical; winds in the planetary boundary layer; surfaces of discontinuity; mechanisms of pressure change; vorticity and circulation.

[417 Physical Meteorology. Fall term. Credit three hours. Given in alternate years. Prerequisite: one year each of calculus and physics. M W F 12:20. Bradfield 1102. Mr. Knapp. Not given in 1972–73.
Primarily, a survey of natural phenomena of the atmosphere with emphasis on their underlying physical principals. Topics include: composition and structure of the atmosphere; atmospheric optics, acoustics and electricity; solar and terrestrial radiation; principals of radar probing of the atmosphere.]

432 Synoptic Meteorology. Spring term. Credit three hours. Time to be arranged. Instructor D. Paine. Prerequisite: 431 and permission of the instructor.
This will complement the 431 course with a four-dimensional look at the atmosphere's structure. The laboratory, meeting twice weekly, will put into practice the theory of isentropic analysis.

438 Atmospheric Pollution. Spring term. Credit three hours. Given in alternate years. Prerequisite: one year each of calculus and physics. M W F 9:05. Bradfield 105. Mr. D. Paine.
Nature of air pollution; its dispersals by atmospheric processes and its effects upon the atmosphere and biosphere.

449 Physics of Clouds, Rain, and Rainmaking. Fall term. Credit three hours. Given in alternate years. Prerequisites: one year each of calculus and physics. M W F 12:20. Bradfield 1102. Mr. Knapp.
The course is primarily centered on the microphysical processes occurring in natural clouds which lead to the development of precipitation. Subject matter includes: a brief survey of the macrophysical properties of clouds; homogeneous and heterogeneous condensation processes; growth of cloud particles; natural and artificially stimulated precipitation processes.

462 Undergraduate Research in Meteorology. Fall and spring terms. Credit one to three hours. Required of honor students in the physical sciences majoring in meteorology. Staff.

550 Special Topics in Meteorology and Climatology. Fall or spring term. Credit one or more hours. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Staff.
Study of meteorological topics more advanced than or different from those in other courses. Subject matter depends on the background and desires of those enrolling.

562 Research in Meteorology. Fall and spring terms. Credit one or more hours. Thesis research. Staff.

691 Seminar in Meteorology. Prerequisite: permission of the professor in charge. Mr. Dethier.
Subjects for future times may be such things as weather modification, paleoclimatology, atmospheric pollution. These will be planned and announced in advance.

Natural Resources

The Department of Natural Resources offers a wide variety of educational opportunities to study natural resources. For undergraduates, there are course sequences in fishery science, wildlife science, forest science, outdoor recreation, and environmental conservation. For graduate students there are available as major subjects: fishery biology, wildlife science, natural resources conservation; and, as a minor subject, forest conservation. There may be emphasis in international studies in these subjects. The graduate minor in water resources may be taken in this Department under Messrs. Eipper, Hamilton, Oglesby, or Wilkins.

Other areas of study in the natural resources field include programs in soil and water conservation in the Department of Agronomy, conservation education in the Department of Education, and resource economics in the Department of Agricultural Economics.

101 Orientation in Natural Resources. Fall term. Credit one hour. Enrollment restricted to freshmen and transfer students in the Department of Natural Resources, or by permission of Instructor. Time to be arranged. Staff.
An introduction to the field of natural resources. The student is exposed to the professional positions, and the Department's role, in the field. Field trips will be taken.

110 Ecological Basis for Conservation. Spring term. Credit two hours. Lecture, T Th 10:10 or 12:20. Ives 120. Mr. McNeil.
Ecological principles as applied to man's use of his environment, especially its living components. Survival strategies of animals and the application of these concepts to man. Ecological succession, carrying capacity, limiting factors, population dynamics, animal behavior, disease, effects of pesticides on living organisms and systems, other contaminants, noise, heat, nuclear radiation, extinct and endangered species, management of plants and animals and the land, pressures on natural systems caused by technology and increasing human populations, and what to do about it.

201 Environmental Conservation. Fall term. Credit two hours. T Th 10:10. Ives 120. Mr. McNeil.
Man, natural resources, and environment. Man's use and misuse of the natural components of his environment. Current resource use problems such as air and water pollution, radiation, garbage and waste, and the population explosion. A brief survey of natural resources emphasizes land, water, soil, plants and animals, minerals and energy. Resource-use policies are related to social problems, and an attempt is made to introduce the concept of a conservation ethic.

202 Environmental Conservation Discussions. Fall term. Credit one hour. Corequisite: 201. Times and places to be arranged. Staff.
Treatment of lecture material from 201 in greater depth and with various emphases depending on the background and interests of the instructors and students.

415 Public Relations in Natural Resources Management. Spring term. Credit three hours. Prerequisite: at least junior standing. Other than Natural Resources majors must have consent of instructor. Limited to 35. Lecture, M W 9:05. Fernow 210. Laboratory, Th 1:30–3:30. Warren 101. Mr. Dickson.
Methods of attaining and maintaining good public relations in the natural resource management professions through the use of effective communications, the media, biopolitics, and understanding the publics involved.

430 Population Dynamics of Fish and Wildlife. Spring term. Credit two hours. Prerequisite: senior or graduate standing in the Department of Natural Resources, or consent of instructor. T Th 10:10. Fernow 210. Staff.
Characteristics of fish and game populations and the analysis of data for purposes of projection. An examination of the processes that control the abundance of organisms. This course includes a consideration of mortality, reproductive potential, density-dependent and density-independent regulation, predator-prey and parasite-host relationships. Examples are taken mainly from areas of fishery and wildlife science. Emphasis will be placed on the practical application of course material.

The Vertebrates (Biological Sciences 273).

General Ecology (Biological Sciences 361).

Introductory Entomology (Entomology 210).

Resource Analysis and Planning

203 Natural Resource Inventories. Spring term. Credit three hours. Limited to 35 students. Lecture, M T 12:20. Laboratory, T 2. Fernow 210. Mr. Hardy.
Procedures for inventorying resources, the methods used, and theories of inventory development in relation to present needs. Examination of the processes used in generating currently used inventories, application of methods to improve existing inventories, and experience in developing inventories will be undertaken. Laboratory section offers opportunity to generate inventories of resource information for a selected township. Several field trips.

421 Seminar in Remote Sensing of Natural Resources. Fall term. Credit two hours. T 7–9. Fernow 304. Mr. E. E. Hardy.
Characteristics of various remote sensors will be described and their sensor capability identified. Current and potential applications for sensing natural resources will be considered and simulated, and actual problems of benefit analysis undertaken. Guest lecturers.

510 Perspectives on Conservation. Fall term. Credit two hours. Graduate standing or permission of instructor. Th 2–4. Fernow 210. Mr. Wilkins.
A seminar based upon extensive readings of articles highlighting varying philosophical approaches to the conservation of natural resources. Views espoused by developmentalists, preservationists, naturalists, economists, welfare economists, and urban planners will be considered.

511 International Natural Resources. Fall term. Credit two hours. Upperclassmen and graduate students only. T 3:35. Fernow 304. Mr. Hamilton and Mr. McNeil.
A seminar devoted to exploring international programs of nature conservancy; extinct and endangered species; floral and faunal protection in various countries; national park systems; protection vs. management; the relevance of United States experience; role of

nature conservancy in resource development of emerging nations. Foreign students especially are invited.

602 Seminar in Natural Resource Analysis for Ecologically Based Planning. Spring term. Credit two hours. W 2:30. Fernow 304. Mr. Hamilton.
Multidisciplinary graduate student-faculty-invited specialists seminar. Theme varies from year to year but usually involves a case study of a specific area of land and water. The ecological basis for planning land and water use. Engineers, economists, sociologists, soil scientists, fish or wildlife biologists, foresters, ecologists, and planners especially invited. Field work involved.

604 Seminar on Selected Topics in Natural Resources Conservation. Spring term. Credit one hour. Time to be arranged. Mr. Brumsted and staff.
Primarily for graduate students majoring or minoring in natural resources conservation.

498 Research in Resource Analysis and Planning. Either term. Permission of instructor. Messrs. Brumsted, Hamilton, McNeil, and Wilkins.

499 Research in Remote Sensing of Resources. Either term. Permission of Instructor. Mr. Hardy.

Resources Economics (Agricultural Economics 450).

Evaluating Environmental Quality (Agricultural Economics 350).

Ecological Aspects of Evaluating Environmental Quality (Agricultural Economics 350A).

Analysis and Interpretation of Aerial Photographs (Engineering 2484).

Physical Environment Evaluation (Engineering 2482).

Outdoor Recreation

420 Outdoor Recreation. Fall term. Credit two hours. Prerequisite: 201. Open to seniors and graduate students and to juniors with permission of the instructor. T Th 11:15. Fernow 210. Mr. Wilkins.
Factors involved in allocating natural resources for outdoor recreation are considered. Characteristics of public and private administration of recreation area are studied and trends in outdoor recreation explored.

420A Field Studies in Outdoor Recreation. Fall term. Credit one hour. Open to seniors and graduate students. Prerequisite: 420 or concurrent registration. W 2–4:25. Fernow 210. Mr. Wilkins.
A laboratory to be taken by students desiring experience with applied aspects of outdoor recreation data collection and analysis.

493 Research in Outdoor Recreation. Either term. Permission of instructor. Mr. Wilkins.

Economics of Recreation and Leisure (CEPP 425).

Recreation Planning (Landscape Architecture 436).

Forestry

302 Forest Ecology. Fall term. Credit three hours. Limited to 40 students. Lectures, M W 11:15. Laboratory, M 2–5. Bradfield 105. Mr. Hamilton.
Understanding the wildland environment. Development of ability to identify and analyze what is present, what was present, what is likely to happen in various forest ecosystems. All laboratory sessions in the field. One required weekend trip to the Adirondacks or other major forest region.

303 Woodlot Management. Fall term. Credit three hours. Lecture, M W 11:15. Laboratory, W 1:45–4:25. Bradfield 108. (Three field laboratories will end at 5:15 because of travel time.) Mr. Morrow.
Designed to give the student the basic information necessary to permit sound woodland management decisions. Field trips to woodlots emphasize variations in value and potential as well as biological growth. Introduction to tree identification, log scaling, timber estimating, tree marking, and stand improvement work. Planting, management, harvesting, marketing, Christmas trees, maple syrup, and multiple use are discussed, as well as relationships of forestry to people and to the environment.

496 Research in Forestry. Messrs. Dickson, Hamilton, Morrow, and Winch.

Fishery Biology

[439 Fish Ecology. Fall term. Credit three hours. Prerequisite: Biological Sciences 361 and 468 or permission of instructor. M W F 10:10. Bradfield 108. Not given in 1972.
Interactions between fishes and their living and nonliving environment, and applications of ecological principles to fish population research and management. Population ecology; interspecific relationships of fishes including competition, predation, parasitism, and commensalism, and relationships of fishes to other organisms. Adaptations, diversity of life history and behavior patterns, and usual inhabitants of major habitat types are considered. The ecology of young fishes is stressed, and the student is introduced to the literature of fishery biology.]

440 Fishery Science. Fall term. Credit four hours. Students other than majors in the Department must have permission of instructor to register. M W F 12:20. Laboratory, W 1:25–4:30. Warren 260. Mr. Youngs.

Principles and theories involved in dynamics of fish populations. Methods of obtaining and evaluating statistics of growth, population size, mortality, yield and production, as well as investigational aspects of fishery biology are included. Laboratory will consist of field experience in obtaining and analyzing information necessary for estimating vital statistics of fish populations.

441 Fishery Resource Management. Spring term. Credit three hours. Prerequisite: 439 and 440 or permission of instructor. Lecture, T Th 11:15. Fernow 210. Discussion to be arranged. Mr. Eipper.
Principles and problems in the management of freshwater and marine fishery resources, considered in relation to problems of human population and management of other natural resources. Multiple use concepts, allocation problems, and the economic, legal, and political ingredients in solving those problems. Characteristics of fishery resources and their exploitation. Policies and techniques in managing fish stocks through maintenance and improvement of habitat, fish population manipulation, and regulation of fishing.

443 Ecological Aspects of Water Resources Management. Fall term. Credit three hours. Limited to 30 students; seniors or graduate students only. T Th 9:05. F 1:25–4:25. Caldwell 250A. Mr. Oglesby.
Basic structural and dynamic aspects of freshwater and estuarine ecosystems are reviewed. The nature and modes of action of stresses imposed by man on the systems and their significance to management decisions are then studied. Students will become acquainted with some of the more important laboratory and field study tools.

600 Seminar: Major Fishery Investigations. Spring term. Credit one hour. Given in alternate years. Prerequisite: permission of instructor. W 12:20. Staff.
A comparative review of major fishery investigations of the world constitutes the primary content of seminar. A study of pertinent literature and special topics will be assigned.

601 Seminar or Selected Topics in Fishery Biology. Fall or spring term. Credit one hour. Time to be arranged. Staff.

494 Fishery Biology. Messrs. Eipper, Forney, Oglesby, Schofield, Webster, and Youngs.

Bionomics of Fresh-Water Invertebrates (Entomology 471).

Biology of Fishes (Biological Sciences).

Oceanography (Biological Sciences 461).

Ichthyology (Biological Sciences 470).

Marine Ecology (Biological Sciences 566).

Limnology (Biological Sciences 462).

Biology of Algae (Biological Sciences 344).

Wildlife Science

304 Wildlife Ecology. Fall term. Credit two hours. T Th 10:10. Warren 145. Mr. Moen.
Consideration of the basic physical, physiological, interspecific, and intraspecific relationships of the organism and its environment.

410 Principles of Wildlife Management. Fall term. Credit three hours. Prerequisite: junior standing and one ecology course. M W F 9:05. Warren 145. Instructor to be appointed.
Fundamental characteristics and mechanisms of wildlife population and habitats. Includes ecological, social, and economic aspects of wildlife management.

411 Wildlife Management Methods. Spring term. Credit two hours. Prerequisite: 410. F 11:15, 1:25–4:30. Several all-day field trips. Fernow 210. Instructor to be appointed.
Introduction to methods of management of wildlife and practical application of these techniques in the field. Intended for wildlife science majors.

412 Wildlife Management Laboratory. Fall term. Credit one hour. Prerequisite: 410 or concurrent registration. F 1:25–4:30. Several all day field trips. Fernow 212. Instructor to be appointed.
Laboratory problems in wildlife management. Involves data collecting and analysis. Intended for wildlife science majors.

414 Advanced Wildlife Science. Spring term. Credit three hours. Prerequisite: 410 and 411. T Th 11:15. Bradfield 105. Staff.
Nutrition, behavior, and management of free ranging wildlife.

495 Research in Wildlife Science. Fall and spring terms. Credit and time to be arranged. Prerequisite: adequate preparation in the specialized field and permission from an instructor. Fernow Hall. Staff.
Research work on problems of mutual interest to students and staff.

504 Analytical Ecology. Spring term. Credit three hours. Prerequisite: permission of the instructor. T Th 9:05. Fernow 210. Laboratories to be arranged. Mr. Moen.
Basic physical, chemical, physiological, and behavioral relationships between free-ranging animals and their environment are analyzed. Both domestic and wild animals are considered, with the emphasis on wild and domestic ruminants and upland game birds.

603 Wildlife Science Seminar. Fall and spring terms. Credit one hour. Prerequisite: consent of instructor. W 3:35. Fernow 304. Staff.
Discussion of individual research or current problems in wildlife science.

Mammalogy (Biological Sciences 471).

Ornithology (Biological Sciences 472).

Soils (Agronomy 200).

500 Thesis Research and Professional Projects. Fall and spring terms. Credit and hours arranged. S-U grades only. Staff.
Limited to graduate students working on thesis research or professional Master's projects.

610 Conservation Seminar. Fall and spring terms. Noncredit. Th 4–5:30. Fernow 304. Staff.
All graduate students in the Field of Conservation are expected to participate.

Plant Breeding and Biometry

Four-year students interested in specializing in genetics, plant breeding, or statistics may obtain suggested sequences of courses by consulting the head of the Department or other members of the faculty. Professional careers in these fields ordinarily involve advanced study. Therefore, undergraduate course work in most instances will be directed toward preparation for graduate study. Appropriate fundamental courses in biology, mathematics, chemistry, and English will make up the bulk of the curriculum.

Plant Breeding

503 Methods of Plant Breeding. Fall term. Credit four hours. Primarily for graduate students, but open to qualified seniors who expect to engage in plant breeding. Prerequsite: Biological Sciences 101–102 and 281, and a course in at least one of the following: field crops, vegetable crops, floriculture, or pomology. T Th 8. Bradfield 108. Laboratory discussion T Th 2–4:25. Bradfield 108. Mr. Munger and Mr. Murphy.
Breeding systems for producing the possible crop variety forms are considered in detail. Laboratories include controlling pollination, producing heritable variation, and selection techniques with emphasis on disease resistance. There will be a Saturday field trip to Geneva.

505 Physiological Genetics of Crop Plants. Spring term. Credit three hours. Prerequisites: Biological Sciences 281 and a course in biochemistry or plant physiology, or permission of the instructor. Lecture, T Th 9:05. Bradfield 108. Discussion, T 1:25–4:25. Bradfield 105. Mr. Wallace.
Genetic, biochemical, and molecular mechanisms controlling plant variation in physiological phenomena such as photosynthesis, respiration, translocation, self-incompatibility, male sterility, seed dormancy, yield, and heterosis will be discussed. Biochemical and molecular mechanisms through which environmental factors like temperature, light, mineral elements, and water interact with genetics to alter phenotypic expressions of plant growth and development will also be covered. These genetic, physiological, biochemical, and environmental phenomena will be presented from data obtained through studies with higher plants. Emphasis will be upon physiological variation that can be exploited in plant breeding.

506 International Crop Breeding and Improvement. Fall term. Credit two hours. Given in alternate years. Prerequisite: 503 or consent of the instructor. Lecture, Th 9:05. Bradfield 108. Discussion, Th 2:30–4:25. Bradfield 105. Mr. Crowder.
Discussion of plant breeding principles and procedures as related to situations found in different parts of the world. Particular attention will be given to alternate approaches in breeding and crop improvement programs in developing countries and to cropping systems and agronomic practices which influence crop productivity. Specific reference materials and examples will be drawn from current activities in tropical agricultural regions. Student participation is expected.

507 Research Orientation. Spring term. Credit two hours. Prerequisite: 503. Lectures, M W F 9:05 for the first ten weeks of the semester. Bradfield 108. Mr. Grogan and staff.
Designed to acquaint the student with the various facets of research in plant breeding. Particular attention will be given to concepts, philosophies relating to plant research, and oral and written communication procedures in research.

512 Experimental Methods. Spring term. Credit two hours. Given in alternate years. Prerequisite: 511 or consent of the instructor. M W F 12:20. Bradfield 108. Mr. Lowe. Not given in 1973–74.
Use of statistical methods and application of experimental designs and plot techniques to problems in plant breeding and related agricultural research.

516 Advanced Topics in Plant Genetics and Breeding. Fall term. Credit three hours. S-U grades only. Graduate students only. Lectures, M W F 8. Laboratory discussion, W 2:30–4:25. Emerson 334. Messrs. Jensen, Gracen, and Plaisted.
Designed for study in depth of advanced research and other topics of special relevance to plant genetics and breeding. Examples of research topics are: somatic hybridization, host-pathogen relationships, breeding for disease and insect resistance, parameters of yield, mutation or radiation breeding, uses of male steriilty, world germ-plasm resources, mass selection, plant competition, and population dynamics.

550 Special Problems in Research and Teaching. Fall, spring, or summer. Credit one or more hours by arrangement with instructor. Undergraduates must attach to their preregistration material, written permission from the

staff member who will supervise the work and assign the grade. Members of the departmental staff.

622 Seminar. Fall and spring terms. Without credit. T 12:30. Emerson seminar room. Members of the departmental staff and graduate students.

Plant Pathology

The Department offers programs of instruction in plant pathology, mycology, plant nematology, plant virology, phytobacteriology, dendropathology, and disease physiology. In consultation with an adviser, a student may develop a program to prepare himself for (1) graduate work leading to a career in teaching or research, (2) training as a laboratory or research technician, (3) a career in state and federal regulatory work or as a county agent, or (4) a career in agricultural chemical sales or technical service. An undergraduate major in the field is not required for graduate work in mycology or plant pathology.

301 Elementary Plant Pathology. Every fall and alternate spring terms. Credit four hours. Given in spring 1973. Prerequisite: Biological Sciences 101–102 or 103–104, or the equivalent. Lecture, T Th 11:15. Plant Science 37. Laboratory, T W Th or F 2–4:25. Plant Science 341. Conferences to be arranged. Mr. Boothroyd.
An introductory course dealing with the nature, cause, and control of disease in plants. Representative diseases of cultivated crops are studied in the laboratory.

[302 Plant Disease Control Practices. Spring term. Credit three hours. Given in alternate years. Prerequisite: 301 or equivalent. Lecture, T Th 11:15. Plant Science 336. Laboratories and recitation, Th 1:25–4:25. Plant Science 342. Mr. Fry. Not given in 1972–73.
For undergraduates who expect to engage in general farming; in fruit, vegetable, cereal, or ornamental growing; in agriculture agent work; or in teaching of agriculture in secondary schools. Consideration is given to modern methods for controlling diseases of plants through production and use of disease-free propagative materials, seed treatments, regulatory laws, crop rotation, plant surgery, sanitation, soil treatment, spraying and dusting, and development and use of disease resistant varieties. Field trips arranged to observe disease control practices.]

309 Comparative Morphology of Fungi. Fall term. Credit four hours. Prerequisite: a year sequence of botany or its equivalent, and permission to register. Lecture and Laboratory, T Th 1:25–4:25 and one additional two-hour period to be arranged. Plant Science 326 and 336. Mr. Lorbeer.
An introductory course in mycology. Emphasis is placed on morphology rather than on taxonomy.

403 Pathology of Trees and Shrubs. Spring term. Credit three hours. Prerequisite: 301 or the equivalent. Lectures, W F 10:10. Plant Science 336. Laboratory, F 1:25–4:25. Plant Science 342. Mr. Sinclair.
For students desiring some specialized knowledge of diseases of trees and shrubs in preparation for nursery or landscape work, for careers as park superintendents, arborists, or city foresters, or for other horticultural professions; deals with the nature, recognition, diagnosis, and treatment of diseases of woody plants.

431 Undergraduate Research in Mycology or Plant Pathology. Fall or spring term or both. Credit three to five hours. S-U grades optional. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Not less than three laboratories of three clock hours per week. Staff members.
Designed to afford opportunity for selected undergraduates to test their inclinations and ability to do research work. The student is expected to prosecute with interest and enthusiasm, under informal direction of the professor, some problem or problems mutually agreed upon.

501 Advanced Plant Pathology. Fall term. Credit five hours. Prerequisite: a course in introductory plant pathology and permission to register. Lecture, T Th 11:15. Plant Science 336. Laboratory, T Th or W F 2–4:25. Plant Science 342. Mr. Millar.
Designed to acquaint the student with the basic principles and techniques of the science of phytopathology and to provide an adequate foundation for successful prosecution of research in this field.

502 Principles of Plant Disease Control. Spring term. Credit three hours. Given in alternate years. Graduate students only. Enrollment limited to 24. Prerequisite: 501 or its equivalent and permission to register. Lecture, T 11:15. Plant Science 336. Laboratory and discussion, T Th 2–4:25. Plant Science 342. Mr. Fry.
Emphasis is placed upon the philosophies underlying the principles of plant disease control. Attention is given to the existing body of knowledge upon which present disease control practices are based. Objectives are to help the student interested in plant protection equip himself not only to apply existing methods and materials but to enable him to improve upon them by developing new ideas, etc., especially in situations where control of plant diseases requires new approaches.

505 Plant Virology. Fall term. Credit three

hours: in special cases permission may be obtained to enroll for lectures only (two hours credit). For graduate students with majors or minors in plant pathology; also open to graduate students interested in general virology. Prerequisite: 501 or permission to register. Lecture, T Th 10:10. Plants Science 336. Laboratory, F 1:25–4:25. Virology-Nematology Laboratory. Mr. Ross.
Designed to provide advanced graduate students with basic information on the plant viruses and on the diseases they cause.

[506 Plant Nematology. Spring term. Credit three hours. Given in alternate years. For graduate students with majors or minors in plant pathology and, in special cases, other students interested in nematology. Prerequisite: 501 or permission to register. Two lectures and one or two three-hour laboratory periods per week. Hours to be arranged. Lectures, Plant Science 336. Laboratory, Virology-Nematology Laboratory. Mr. Mai. Not given in 1972–73.
Anatomy, morphology, and taxonomy of plant parasitic forms and nonparasitic soil-inhibiting forms of nematodes are studied. Plant pathogenic forms also are considered from the standpoint of host-pathogen relationships, host ranges, life cycles, and the symptoms they cause. Principles and methods of control are discussed.]

507 Bacterial Plant Pathogens. Spring term. Credit three hours. Given in alternate years For graduate students with majors or minors in plant pathology; others by permission only. Prerequisite: 501 or permission to register. Lecture, F 9:05. Plant Science 336. Laboratory, W F 2–4:25. Plant Science 304B. Mr. Dickey.
Designed to provide students with basic information on bacterial plant diseases and phytopathogenic bacteria. The laboratory will include some of the more important techniques used in the study of bacterial plant pathogens.

[508 Disease and Pathogen Physiology. Fall term. Credit three hours. Given in alternate years. For graduate students with majors or minors in plant pathology; others by permission only. Prerequisite: 501, Biological Sciences 240 and 431, and permission to register. Lecture, W 10:10. Plant Science 336. Laboratory, W 1:25–4:25 and one to be arranged. Plant Science 344. Mr. Bateman and Mr. Van Etten. Not given in 1972–73.
Designed to provide students with insight into the mechanisms of pathogenesis and altered metabolism of diseased plants.]

[521 Experimental Methods in Plant Pathology. Fall term. Credit two hours. Given in alternate years. For graduate students with a major or minor in plant pathology; others by permission only. W F 10:10. Plant Science 422. Mr. Horst. Not given in 1972–73.
Designed to provide students with basic information on the application of statistical procedures and experimental designs in plant pathological research.]

531 Special Problems in Mycology or Plant Pathology. Fall or spring term, or both. Credit three or five hours each term. For graduate students only. Registration by permission. Three to five weekly laboratory periods of three hours each. Staff members.
For work in mycology, modern techniques and experimental approach are stressed, in areas such as physiology, developmental morphology, genetic systems, or cytotaxonomy.
For work in plant pathology for minor thesis or problems, or for students wishing to develop familiarity with modern techniques in some phase of the science.
For work in plant nematology, research projects in five areas are stressed. These areas include host-parasite relations, virus transmission, nematode-fungus-bacterium relations, biology, behavior, population dynamics, reproduction and growth, morphology, taxonomy, techniques, and control.

[541 Philosophy of Plant Pathology. Fall term. Credit two hours. S-U grades only. Given in alternate years. For Ph.D. students majoring in plant pathology. Prerequisite: 501, 579, and at least two other courses from 502, 505, 506, 507, and 508, or permission to register. Conferences, M W 8–10. Plant Science 422. Mr. Kent. Not given in 1972–73.
A conference with advanced graduate students examining the concepts of plant pathology as they relate to the approach to basic and applied research problems, teaching, and extension.]

556 Advanced Plant Nematology. Fall and spring terms. Credit three hours. For graduate students only. Prerequisite: Plant Pathology 506. Hours to be arranged. Laboratory: Virology-Nematology Laboratory. Mr. Mai.
Graduate students with special interest in plant nematology will conduct 4 research projects in areas such as taxonomy, morphology, permanent mounting, soil and plant sampling procedures, procedures for extracting nematodes from soil and plant tissues, culturing, host-parasite relationships between nematodes and microorganisms, and evaluation of control practices. This research is intended to broaden training in plant nematology and thus the projects selected will not duplicate thesis research.

[579 Advanced Mycology. Spring term. Credit four hours. Given in alternate years. Prerequisite: 309 or its equivalent, a course in genetics, and permission to register. Lecture, M 10:10. Plant Science 336. Laboratory, M W 1:25–4:25 and one additional three-hour period to be arranged. Plant Science 326. Mr. Korf. Not given in 1972–73.

A detailed study of the biology and taxonomy of the major groups of plant pathogenic fungi (rusts, smuts, Fungi Imperfecti, Peronosporales) with emphasis on mechanisms of variation in fungi. *Optional* field trips.]

[599 Taxonomy of Fungi. Fall term. Credit four hours. Given in alternate years. Prerequisite: Plant Pathology 309 or its equivalent, a course in genetics, a course in plant or animal taxonomy, and permission of the instructor to register. Lecture, M W 10:10. Plant Science 336. Laboratory, M W 1:25–4:25. Plant Science 326. Mr. Korf. Not given in 1972–73.
Emphasis is placed on the principles of taxonomy and nomenclature, critical evaluation of keys and monographs, and practice in identification. The Discomycetes, from which most examples are drawn, are treated in detail. *Required* field trips.]

645–656 Current Topics. Fall and spring terms. Credit to be arranged. For graduate students with special interests in the particular area. Prerequisite: permission to register. Time to be arranged. Plant Science 422.
Weekly discussions of current topics in special areas of plant pathology and mycology. Students will be required to do extensive reading of current literature and to present oral and written reports.

645 Plant Virology. S-U grades only. Mr. Rochow and Mr. Ross.

646 Plant Nematology. S-U grades only. Mr. Mai.

647 Bacterial Plant Pathogens. S-U grades only. Mr. Dickey.

648 Physiology of Plant Diseases. S-U grades only. Messrs. Bateman, Millar, and Van Etten.

[649 Mycology. S-U grades only. Mr. Korf. Not given in 1972–73.]

650 Diseases of Vegetable Crops. S-U grades only. Mr. Lorbeer and Mr. Wilkinson.

653 Pathology of Trees and Shrubs. S-U grades only. Mr. Sinclair.

654 Diseases of Florist Crops. S-U grades only. Mr. Horst.

655 Plant Diseases in Tropical Agricultural Development. S-U grades only. Mr. Thurston.

656 Environmental Aspects of Plant Disease. S-U grades only. Mr. Dimock.

661 Seminar. Fall and spring terms. Credit one hour. S-U grades only. Required of all majors in the Department. T 4:30–5:30. Plant Science seminar room. Mr. Lorbeer.

671 Plant Pathology Colloquium. Fall and spring terms. Credit one hour. S-U grades only. First and third Thursdays of each month. 8–10 p.m. Plant Science seminar room. Staff and graduate students.

Virology (Biological Sciences 498).

Pomology

The fruit industry offers opportunities for graduates in production, research, technical service, and distribution as well as teaching. Undergraduate students interested in a professional career in university teaching or in research positions at an experiment station or in industry usually continue their training at the graduate level. A variety of basic courses in science can be included in the curriculum in preparation for this. Students who desire to do their major work in pomology may obtain a suggested sequence of courses for the four-year period by consulting the Department.

General Horticulture (Vegetable Crops 103). Intended for students who want a general course in horticulture covering flowers, fruits, and vegetables.

101 Tree Fruits. Fall term. Credit three hours. Should be preceded or accompanied by an introductory course in biological science. Lecture, T Th 8. Warren 131. Laboratory, W 2–4:25. Plant Science 107. Mr. Edgerton.
A study of the general principles and practices of tree-fruit culture and their relation to the underlying sciences. Topics to be covered include propagation, varieties, orchard management, and growth and fruiting habits. Practical work is presented in grafting, pruning, site and soil selection, and planting.

102 Small Fruits. Fall term. Credit three hours. Should be preceded or accompanied by an introductory course in biological science. Lecture, M W 8. Plant Science 143. Laboratory, M 2–4:25. Plant Science 114. Mr. Tomkins.
A study of the general principles and practices in the culture of grapes, strawberries, brambles, and bush fruits; and their relation to the underlying sciences. Fruiting and growth habits are covered, with practical work in pruning, planting, and propagation. One all-day field trip will be taken.

201 Postharvest Physiology, Handling, and Storage of Fruits. Fall term. Credit three hours. Prerequisite: 101 or 102. Lecture, T Th 8. Plant Science 141. Laboratory, F 2–4:25. Plant Science 114. Mr. Smock.
The chemistry and physiology of fruits as they affect quality and marketability are studied. Handling methods, maturity indices, and storage practices are considered. Practical work involves grading and inspection of fruits and storage of fruit in different ways. One Saturday field trip is required.

202 Advanced Laboratory Course. Spring term. Credit two hours. Th 1:25–4:25. Plant Science 114. Mr. Edgerton and Mr. Oberly. Designed to give more extended practice in the various orchard operations than can be given in 101. Special attention is given to problems of pruning, grafting, orchard soil selection and management, pollination, and spray practice. One or two field trips are taken.

[301 Economic Fruits of the World. Spring term. Credit three hours. Given in alternate years. Prerequisite: an introductory course in biological science, or permission to register. Lecture: M W 8. Plant Science 143. Laboratory, F 2–4:25. Plant Science 114. Mr. Smock. Not given in 1972–73.
The more important subtropical and tropical fruit species such as citrus, banana, mango, coffee, and cacao are considered. Morphology, physiology, and adaptation to climate are stressed rather than details of culture. A broad view of world pomology is given.]

401 Advanced Pomology. Fall term. Credit three hours. Given in alternate years. Prerequisites: 101 or 102 and Introductory Plant Physiology or permission of the instructor. Lecture, M W F 8. Plant Science 114. Mr. Creasy.
A comprehensive study of the principles of Pomology in relation to other sciences and of the application of these sciences and current pomological research to the solution of present and future problems in commercial fruit growing.

501 Special Topics in Experimental Pomology. Spring term. Credit three hours. Given in alternate years. Hours to be arranged. Messrs. Blanpied, Creasy, Oberly, Powell, and Smock.
The student is expected to review critically and to evaluate the more important original papers relating to the various phases of pomological research. Recent experimental methods applicable to the topic are considered in conjunction with appropriate laboratory exercises.

502 Research. Fall, spring, or both terms. Credit two or more hours a term. S-U grades optional. Prerequisite: 401. Undergraduates must attach to their preregistration material written permission from the staff member who will supervise the work and assign the grade. Messrs. Blanpied, Creasy, Edgerton, Elfving, Oberly, Powell, Smock, and Tomkins.

[504 Growth and Development of Woody Plants. Spring term. Credit two hours. Given in alternate years. Primarily for graduate students; undergraduates admitted by prior approval of instructor. Prerequisite: introductory course in plant physiology. Lecture, T Th 9:05. Plant Science 141. Mr. Powell. Not given in 1972–73.
An advanced course dealing primarily with the growth and development of woody plants, with particular reference to fruit trees. Physiological responses will be emphasized, but morphological and biochemical changes will be considered.]

600 Seminar. Fall and spring terms. One hour credit. Required of students taking 502 and graduate students in pomology. Th 4:30. Plant Science Seminar Room. Members of the departmental staff.

Poultry Science

The poultry industry covers opportunities in all phases of production, distribution, technical service, research, and teaching. Suggested sequences of courses are available to students interested in production or in a business allied to it, and to those interested in a career in research, teaching, or commercial work in such specialized fields as genetics, nutrition, physiology, or food technology.

100 Introduction to Poultry Science. Spring term. Credit three hours. Lecture, T Th 11:15. Laboratory, W 2–4:25. Rice 101. On the several days when there are field trips, a longer Wednesday session may be necessary. Mr. Austic.
A general course designed to acquaint the student with the scope of the poultry industry with emphasis on the principles of avian biology and their application in the various phases of poultry production.

270 Poultry Hygiene and Disease. Fall term. Credit two hours. Given in alternate years. Prerequisite: Biological Sciences 290 or 290A, and permission of the instructor. Th 2–4:25. Veterinary College. Mr. Hitchner.
The nature of the infectious and parasitic diseases of poultry and the principles of hygiene applicable to poultry farming for the prevention and control of diseases.

280 Poultry Farm Management. Spring term. Credit three hours. Given in alternate years. Lecture, T Th 10:10. Rice 101. Laboratory, M 2–4:25. Rice 300. Mr. Thacker.
Practical and business management problems of the commercial poultry farm and industry will be studied. Assigned farm studies. Field trips will be taken.

390 Poultry Problems. Fall or spring term. Credit one, two, or three hours. S-U grades optional. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Mr. Young.
Investigation of some problem in the field of poultry science by the student under the direction of a member of the staff.

Principles of Animal Nutrition (Animal Science 410 and 411).

415 Poultry Nutrition. Spring term. Credit one hour. Prerequisite: Animal Science 410 or permission of the instructor. F 11:15. Rice 300. Mr. Nesheim.
Intended to provide a discussion of applications of principles of nutrition to feeding poultry. Feed formulations will be stressed with emphasis on linear programming and computer formulation.

[419 Animal Cytogenetics. Spring term. Credit three hours. Prerequisite: Genetics 281 or Animal Science 221, or the equivalent. Lecture, M W 10:10. Rice 101. Laboratory, M or T 2–4:25. Rice 101. Mr. Bloom. Alternates with Cytogenetics 440. Not given in 1972–73.
An advanced course dealing with the causes and phenotypic effects of chromosomal aberrations in higher animals. The effects of chromosome abnormalities on embryo development, postnatal growth, and behavior are considered. Special attention is given to genetic, physiological and environmental variables that may cause meiotic and mitotic abnormalities. Cytogenetic, cytochemical and cytophotometric techniques are discussed and demonstrated.]

425 Comparative Physiology of Reproduction of Vertebrates. Spring term. Credit four hours. Prerequisite: Animal Science 427 and consent of the instructor. M W 10:10. Laboratory to be arranged. Rice 300. Mr. van Tienhoven.
Sex and its manifestations, endocrinology of reproduction, interactions between endocrine and nervous systems. The laboratory will provide an opportunity for students to design and execute experiments with limited objectives, independently.

440 Anatomy of the Fowl. Fall term. Credit three hours. Open to juniors. Prerequisites: Biological Sciences 102 or 104 and prior permission of the instructor. Lecture, T Th 8. Rice 201. Laboratory, F 2–4:25. Rice 201. Mr. Cole.
The lectures, supplemented by laboratory periods for study and dissection, are designed to acquaint the student with the anatomy of the fowl.

450 Poultry Meat and Egg Technology. Spring term. Credit three hours. Given in alternate years. Prerequisite: Chemistry 355, or its equivalent, and Biological Sciences 290. Lecture, T Th 9:05. Laboratory to be arranged. Rice 101. Mr. Vadehra.
A discussion and study of some of the important microbial and nonmicrobial changes in poultry meat and eggs as well as the chemical composition and preservation of these products. Development of new products is also emphasized.

Meat and Meat Products (Animal Science 290).

511 Special Topics in Nutrition. Fall or spring term. Credit and hours to be arranged. For graduate students only. Registration by permission of staff members concerned. Messrs. Austic, Nesheim and Scott.
For students desiring experience in planning, conducting, and reporting independent research projects in poultry nutrition.

609 Seminar in Poultry Biology. Fall and spring terms. S-U grades only. For graduate students. Th 4:15. Rice 201. Members of the Department staff.
A survey of recent literature and research in poultry biology.

619 Field of Nutrition Seminar. Fall and spring terms. No credit. M 4:30. Fall, Morrison 348. Spring, Savage 100.
Current research in nutrition presented by visitors and faculty.

Advanced Nutrition. (See description under Animal Science.)

Protein and Amino Acids (Human Nutrition and Food 501). (See the *Announcement of the College of Human Ecology.)*

502 Lipids and Carbohydrates. Fall term. Credit two hours. T Th 11:15. Rice 300. Mr. Bensadoun.

Nutritional Energetics (Animal Science 503).

504 Vitamins and Minerals. Spring term. Credit two hours. T Th 11:15. Rice. 300. Mr. Scott.

Rural Sociology

Students who specialize in rural sociology may choose a sequence of courses designed (1) to provide a broad general understanding of rural societies, methods of analyzing societal systems, how they are organized, the interaction of individuals, groups, organizations, and institutions undergoing modernization and change; (2) to offer training in strategies of domestic and international development; (3) to prepare for professional careers in research, teaching, and public service roles. Graduate study is essential for those wishing to become professional sociologists.

100 General Sociology. Fall or spring term. Credit three hours. May not be taken by those who have credit for Sociology 101. T Th 10:10. Warren 45. One period discussion sections: fall, M or F 9:05–2:15, Warren 232; spring, M or F 9:05–2:15, Warren 361. Fall term, Mr. Eberts. Spring term, Mr. Converse and staff.
A general introduction to the theory and methods of sociology. Major topics selected for discussion include socialization, deviancy

and social control, stratification, ideologies, and social change. Supplementary reading includes recent research assigned for illustrative purposes to assist students in analyzing topical areas as term projects.

200 Analysis of Selected Societal Field Problems. Spring term. Credit three hours. Prerequisite: 100. Enrollment limited to 100. T Th 10:10. Warren 245. Discussion sections to be arranged. Staff.
Designed to follow course 100 through a close student-teacher working relationship. The course will enable students to explore in greater depth selected societal issues and problems. The four main areas with which the course will be concerned are: (1) growth and stagnation; (2) power, class, stratification, and poverty; (3) race relations; (4) social protest. These topics will be analyzed and compared at three levels of analysis: community, national, and international.

210 Foundations for Decision Making and Social Action. Fall term. Credit three hours. S-U grades optional. Not open to freshmen. M W F 10:10. Warren 145. Mr. Reeder.
The purpose is to provide the basic information essential to an understanding of decision making, social action, and planned change. The course is designed for two categories of students: (1) students of various fields who wish to take one or two courses in sociology and who want to gain the kind of knowledge that relates directly to human relationships in their occupation and in their activities as organization members and citizens; (2) persons whose work or interests are likely to involve them in some phase of planned change—either as administrators, organization leaders, extension agents, teachers, or community development workers—and others for whom the role of change agent is an essential part of their job.

220 Introductory Research Methods. Fall term. Credit three hours. S-U grades optional. T Th 1:25–2:55. Plant Science 143. Mr. Francis.
The course intends to initiate an interest in the strategies of both discovery and proof in social research. Problems of theory construction, concept formation and logical validity will be examined in the first part of the course. A second part of the course will be devoted to empirical research by survey technique. Problems of hypotheses formation, statistical inference and techniques of analysis will be discussed. A third part of the course will be concerned with model building as well as some criteria of legitimacy of evidence. As the course proceeds students will be encouraged to analyze their own data or work on the data set available for the course. It is expected that students will gain some familiarity in computer analysis and machine use.

230 Recreation Leadership. Spring term. Credit two hours. Lecture, W 1:25. Laboratory, W 7:30–9:10 p.m. Warren 160. Maximum 25 undergraduates; permission of instructor. Mr. Scott.
Background and theoretical framework for recreation leadership which provide the setting for recreation programming and leadership. Lectures, weekly laboratory in recreation leadership, and field assignments.

310 Rural Minorities in Comparative Perspective. Fall term. Credit three hours. Not open to freshmen. T Th 3:00–4:15. Warren 201. Mr. Converse.
The notion of internal colonialism will be examined as a framework for studying the situation of minority groups in various countries. Factors affecting the amount of social mobility and the degree of incorporation of marginal groups into the larger society will be examined. Action strategies for mobilizing groups toward higher levels of participation will be considered. Major emphasis will be directed toward rural Blacks, Chicanos, and Indians. But the situation of other ethnic minorities in the U.S. and the situations of minority groups in other countries will also be considered.

334 Rural Social Problems and Public Policy. Spring term. Credit three hours. Given in alternate years. Not open to freshmen or sophomores. M W F 9:05. Warren 160. Mr. Larson.
Social problems in American rural life and an analysis of the policy-making process. Primary emphasis is on the sociological aspects of current public problems in the United States such as low-income farmers, migratory agricultural labor, and social services. Each problem selected is analyzed in terms of historical background, public policy, national programs, and the consequences of the policy and program.

350–352 Informal Study. Throughout the year. Credit one to three hours. S-U grades optional. May be repeated. Undergraduates must attach to their preregistration material written permission from the faculty member who will supervise the work and assign the grade.

350 Readings

351 Research Experience

352 Public Service Experience

353 Undergraduate Teaching Experience. Fall or spring. Credit one to three hours. S-U grades optional. Assistants only. May be repeated. Participation in the ongoing teaching program of the department. Undergraduates must attach to their preregistration material written permission from the faculty member who will supervise the work and assign the grade.

365 National Development Policies and Locality Programs. Spring term. Credit three hours. W 2:30. Warren 345. F 1:25–3:20. Warren 261. Mr. Cummings.
A comparison of national policies and programs as implemented at local levels in the United States, Canada, and Latin America. The major focus is on policies and programs affecting the development potential of rural or nonmetropolitan areas. A variety of specific development projects are reviewed and evaluated.

380H Independent Honors Research in Social Science. Throughout the year. Credit one to six hours. Open only to candidates who have met the requirements for the Honors program listed on page 11. A maximum of six credits may be earned in the Honors Program.

390 Social Stratification and Change. Fall term. Credit three hours. Prerequisite: R.S. 100 or equivalent, not open to freshmen. M W F 11:15. Warren 145. Mr. Moore.
The focus will be on processes of social stratification as keys to understanding social change. Various theories of stratification will be reviewed before turning to an examination of current research. Particular attention will be given to the relationship between theory and research, especially the choice of indicators of stratification and change.

405 Organization Dynamics. Spring term. Credit three hours. S-U grades optional. Prerequisite: 100 or 210 or permission of the instructor. Not open to freshmen or sophomores. M W 11:15–1:10. Warren 232. Mr. Reeder.
A study of the methods and techniques by which organization consultants, officers, group members, and administrators may increase the effectiveness of organizations. Five categories of organization problems are considered: (1) program problems, (2) leadership problems, (3) membership problems, (4) problems related to meetings, and (5) organizational and public relations problems. Organization theories are presented in relation to their uses in analysis, prediction, diagnosis, and in designing programs to bring about organizational changes. The first hour is a lecture-discussion period; the second hour is a group skills, group process, and group sensitivity laboratory.

411 Community and Regional Development and Planned Change. Spring term. Credit three hours. S-U grades optional. T Th 11:15–12:30. Warren 232. Mr. Capener and Mr. Erickson.
Various strategies of development and planned change will be explored. Reviewed also will be programs, organizations, agencies, and institutions operating in communities and regions that address themselves to various development strategies. Two major emphases are stressed: (1) the structural-functional roles and processes of organizations, agencies, and institutions as they implement programs of change and development in communities and regions; and (2) roles of professionals and change agents representing and operationalizing development units.

412 Rural Society. Fall term. Credit three hours. S-U grades optional. Prerequisite: 100 or equivalent. Not open to freshmen or sophomores. M W F 9:05. Warren 101. Mr. Larson.
Theoretical and methodological problems in the sociological study of rural societies. Principle emphasis is on the development of American rural society, its internal variations, and the changing relationships of the rural and urban sectors. Attention is given to demographic trends, to values, and to the structure, function, and trends of selected major social systems which serve rural people. Some consideration is given to public policy and program implications of the material presented.

420 Comparative Rural Societies. Fall term. Credit three hours. S-U grades optional. M W F 11:15. Warren 231. Mr. Young.
The development of regions and communities is analyzed from a macrostructural perspective, emphasizing the pervasive nature of social communication and symbolic transformations. Results of recent and ongoing comparative studies are reported, and previous theoretical work relevant to structural change—Marx, Durkheim, Parsons, etc.—is reviewed.

421 Community Structure and Change. Fall term. Credit three hours. Open to seniors and graduate students, others by permission. W F 1:25–2:40. Warren 261. Mr. Erickson.
An overview of various models in approaching communities as objects of study. Analysis will focus on the methodologies by which power structures are examined, the relation of local community units to extracommunity systems, the forms of community cohesion and autonomy, the relation of local power structures to decision making, and the relation of changes in division of labor, urbanization, suburbanization, and the values to patterns of community life.

424 Occupations and Social Issues. Fall term. Credit three hours. (S-U grades optional). Prerequisite: course 100 or equivalent. T Th 2:30–3:45. Warren 232. Mr. Taietz.
Campus unrest, crime and social disorders, and other manifestations of social unrest have in recent years focused attention on certain important institutions and related occupations, especially the teacher in the educational system, the police in the judicial system, the physician in the health services,

and the social worker in the welfare structure. The interrelationship between the social structure and these occupations will be studied. Particular attention will be given to analyzing the impact of social change and current controversies on the work environment of physicians, social workers, teachers, and the police; and on the processes by which these occupations select, socialize, and reward their members.

436 Social Movements and the Sociology of Confrontation. Spring term. Credit three hours. S-U grades optional. M 1:25 and W 1:25–3:20 or F 1:25–3:20. Warren 32. Enrollment limited to 25. Mr. Bauder.
Designed to provide opportunity for maximum student participation. Students under faculty supervision will plan and organize the course which will follow a seminar format. The course content will be an interaction between available theories of collective behavior and selected comprehensive case studies. The theories of Blumer, Heberle, the Langs, Smelser, Toch, Turner, Young and others will be used to help understand selected cases from a wide range of social movements such as the Black Power movement, National Farms Organizations, and various student movements.

437 The Sociology of Aging. Spring term. Credit three hours. Open to seniors and graduate students. S-U grades optional. T Th 2:30–3:45. Warren 361. Mr. Taietz.
The theory and research in the sociology of aging will be examined. A major focus will be a critical examination of the disengagement and activity theories of the aging process. A current research project directed by the instructor will be utilized to investigate the effect of differential structural contexts on disengagement, morale, and community integration of the aged. Methodological problems in research on aging will be explored.

440 Introduction to Computer Uses in Data Analysis. Fall and spring terms. Credit three hours. S-U grades optional. Prerequisite: one course in statistics or permission of instructor. T Th 11:15. Warren 345. Laboratory to be arranged. Mr. Moore.
The purpose is to introduce the student who wishes to use the computer in his research. The course is divided into two parts. The first part is designed to give the student a working knowledge of the elementary aspects of Fortran IV so that he will be able to do preliminary transformations of his data and simple Fortran programs. The second part deals with the various "canned" programs which are most often used by social scientists. The student is introduced to program packages such as Michigan, Bimed, and SPSS. Examples will be given on how to run the programs as well as discussions on the differences between them.

443 Politics, Social Control, and Pluralism. Fall term. Credit three hours. S-U grades optional. Open to upperclassmen and graduate students. Prerequisite: 100 or equivalent. T Th 11:15–12:30. Warren 232. Mr. Eberts.
Comparative analyses of substantive and methodological issues in social control processes within the political economies of primarily Western democracies, but with illustrative attention to Communist and developing societies. Pluralism and control will be viewed relative to productive, allocative, and staffing processes of society, as they affect various occupational categories, communities of different size, and institutions primarily responsible for maintaining social order.

501 Interdisciplinary Seminar: Perspectives on Development. Fall term. Graduate students or consent of instructor. T 2:30–5:30. Warren 361. Mr. Cummings.
A comparison of several conceptual frameworks relevant to human development. The central purpose of the seminar is to explore the possibility of designing a more comprehensive theory of development.

510 Seminar on Decision Making and Social Action. Fall term. M F 10:10 and a weekly two-hour laboratory. Time to be arranged. Warren 261. Mr. Reeder.
An introduction to research and theory on decision making and social action at the graduate level. The lectures for 210 are used to provide a systematic presentation of the subject, and the two-hour weekly laboratory is used to discuss additional research and theory related to the topics presented.

[511 The Metropolitan Community. Spring term. Credit three hours. S-U grades optional. Given in alternate years. Graduate student status or consent of an instructor. F 1:25–4:00. Warren 231. Mr. Eberts. Not offered in 1972–73. This course is also given as Sociology 501 and as Planning 714. Students registering for this course must do so under their respective college course number.
An interdisciplinary course focused upon social, political, and economic aspects of metropolitan America. Viewed from the perspective of demography, ecology, social organization, and planning, the emergence of a new society and its implications for contemporary America will be considered.]

514 Research Design I. Fall term. Credit three hours. M W F 10:10. Warren 361. Mr. Francis.
This is the first of a two-semester sequence in graduate-level research methods dealing with data-gathering problems (either course may be taken individually). The first part of this course discusses essentially problems of measurement. Emphasis is upon the design of measuring instruments, problems of

reliability and validity. Some common forms of measuring instruments will be discussed: paired comparisons, Likert and Guttman scales and some discussion of multidimensional techniques. Factor analysis will be included. A second part of the course will deal with sampling frames and some pragmatic techniques as well as some discussion of statistical analysis procedures appropriate under each. A third part of the course will discuss problems of research design and legitimacy of inferences. All throughout the course students are expected to use actual data and thus familiarize themselves with data handling and processing.

515 Research Design II. Spring term. Credit three hours. Prerequisite: an introductory methods course or a statistics course. M W F 10:10. Warren 232. Mr. Francis.
An intermediate level treatment of the following topics: nonexperimental designs, regression analysis, analysis of variance, analysis of covariance, and causal models. A classic piece of sociological research will be one source of illustration and laboratory exercises.

516 Macrostructural Research Methods. Spring term. Credit four hours. T Th 2:30–4:10. Warren 201. Mr. Young.
The comparative study of large social systems is presented as a new research style that is especially appropriate to research in and on developing countries. The field technique of macrosurveys and the uses of available data such as national social accounting, documents, ethnographic reports, and aerial photographs are emphasized. Special attention is given to trend studies; the assumptions of macrostructural analysis; rapid, low-cost research procedures; and the mechanics of data archives.

522 Social Power and Community Decision Making. Spring term. Credit four hours. M and W or F 8–9:55. Warren 261. Mr. Stockdale.
A sociological approach to power as an aspect of community life. The methodology and the theoretical approaches of recent community power studies are analyzed. The importance of social power in community decision making and action programs is considered, and the influence of community power structures in instigating and retarding change is analyzed.

528 Applications of Sociology to Development Programs. Spring term. Credit four hours. Open to graduate students only. T Th 2:30–4:10. Warren 232. Mr. Converse.
Consideration of problems of implementing change strategies at national, regional, and institutional levels, especially as they relate to rural development. Attention will focus on institutional obstacles to increasing the amount of wealth generated in a system as well as existing patterns of wealth distribution and how these can be changed through developmental programs and processes. An examination of the emerging literature on societal or developmental change as contrasted to social or evolutionary change. Consideration of the different contexts within which developmental change occurs and the power balances between different actors in international and national systems.

550(A, B, C, or D) Informal Study. Throughout the year. Credit to be arranged. Prerequisite: graduate standing and permission of the graduate field member concerned.
A Rural Sociology
B Development Sociology
C Organization Behavior and Social Action
D Methods of Sociological Research

551(A, B, or C) Research. Throughout the year. Credit to be arranged. Prerequisite: graduate standing and permission of the graduate field member concerned.
A Rural Sociology
B Development Sociology
C Organization Behavior and Social Action

552 Teaching Experience. Fall or spring. Credit one to three hours. Prerequisite: graduate standing. Participation in the ongoing teaching program of the department.

553 Public Service Experience. Throughout the year. Credit to be arranged. Prerequisite: graduate standing. Participation in the ongoing public service activities of the department.

[624 Seminar: Macro Systems Theory. Spring term. Credit three hours. Given in alternate years. S-U grades optional. T Th 11:15–12:40. Warren 232. Mr. Eberts. Not given in 1972–73.
Analysis of major theoretical and research problems related to conceptualizing stress areas in society's changing organizational processes. Topics will be covered by reports on major classical and contemporary theorists, paying particular attention to their potentiality, using modern analytic techniques on current issues in political economy.]

630 Seminar, Contemporary Social Theory I. Fall term. Credit three hours. T Th 11:15–12:40. Warren 361. Mr. Reeder.
The focus of this course is on: (1) intra- and inter-personal theories; (2) intra- and inter-organization theories; (3) intra- and inter-system theories.

631 Seminar, Contemporary Social Theory II. Spring term. Credit three hours. W F 1:25–2:45. Warren 232. Mr. Reeder.
The focus of this course is on: (1) intra- and inter-community and regional theories; (2) intra- and inter-relations of national societies; (3) intra- and inter-cultural change.

699 Seminar. Fall and spring term. No credit. For graduate students majoring in development sociology. Second and fourth Monday of each month, 3:45–5:05. Warren 32. Departmental staff.

Statistics and Biometry

Four-year students interested in specializing in biometry may obtain suggested sequences of courses by consulting members of the Biometrics Unit, Department of Plant Breeding and Biometry. This biometry program provides both training for numerous positions which are available at the Bachelor's degree level and preparation for graduate study in statistics and biometry. It is recommended that the student be competent in mathematics and at least one other area of specialization in the College. Students should consult faculty of the Biometrics Unit for additional courses in quantitative methods suited to their interests; for example, courses in computer science, mathematics, statistics, systems analysis and others, given elsewhere on campus.

200 Statistics and the World We Live In. Fall and spring term. Credit three hours. Lecture, T Th 11:15. Warren 231. And one of the following discussions: M 10:10, 1:25, 3:25; T 9:05; Th 1:25, 2:30; F 9:05, 12:20. Rooms to be arranged. Preliminary examinations to be given on Thursday evening, 7:30–9:00, on February 17; March 16; and April 20, 1972. Mr. Cady.
Emphasis is on numbers and the use of numbers as related to the many aspects of society. An introduction is given to the basic concepts and definitions in measurement, the principles of scientific experimentation, and graphical presentations. Elementary definitions and concepts of sample survey and experimental design will be presented; considerable emphasis will be placed on obtaining meaningful data related to a phenomenon of interest, and upon designing information into data. Summarizing meaningful facts from the data will involve the use of graphs, tables and ranks and the arithmetic mean, median, mode, variance, and range. Elementary *concepts* of populations, sampling from populations, model building, probability, frequency distributions, and interval estimation of population parameters will be presented. Emphasis will be on ideas, concepts, and understanding rather than on methods. The material in this course is complementary to the material presented in Industrial and Labor Relations 210 and Agricultural Economics 310.

407 Introductory Computer Techniques for Statistics and Biology. Fall term. Credit two hours. Prerequisite or corequisite: an introductory course in statistics. Lecture, M 11:15. Laboratory, M 2–4:30. Warren 101. Mr. Searle.
Introduction to computers, computing languages, and number representation. Preparation and running of computer programs using the FORTRAN programming language; elementary statistical analyses, and techniques of sampling and simulation in statistics and biology.

408 Probability and Statistics I. Fall term. Credit three hours. Prerequisite: Mathematics 106, 108, or 112 or consent of instructor. M W F 10:10. Warren 345. Mr. Solomon.
Elementary probability, random variables, probability distributions, generating functions, and limit theory are considered; biological and statistical applications serve to motivate the presentation.

409 Probability and Statistics II. Spring term. Credit three hours. Prerequisite: course 408 or equivalent. Lectures, M W F 10:10. Warren 345. Mr. Solomon.
The concepts developed in 408 are applied to provide an introduction to the theory of statistical inference. Topics covered include decision theory, sufficiency, estimation, hypothesis testing and linear regression. Biological applications again serve to motivate the presentation.

[411 Stochastic Models in Biology. Spring term. Credit three hours. Prerequisite: 409. Lectures, M W F 10:10. Discussion period to be arranged. Professor to be appointed. Not given in 1972–73.
An introduction to stochastic processes in biology. The necessary mathematics and statistics will be introduced as needed. Recurrent events, random walk models, Markovian processes, birth-and-death processes, epidemic processes, competition and predation, diffusion processes, and other models currently used in biological theory will be discussed and applied. Special emphasis will be given the various processes applied to genetics.]

[412 Deterministic Models in Biology. Spring term. Credit three hours. Prerequisite: 409. Lectures, M W F 10:10. Discussion period to be arranged. Instructors to be appointed. Not given in 1972–73.
An introduction to deterministic mathematical models in biology. The application will be from the biological viewpoint. The necessary mathematics will be introduced as needed. Finite differences, differential equations, logistic, growth and decay, and other deterministic models corresponding to those introduced in 411 will be discussed.]

417 Matrix Algebra. Fall term. Credit three hours. Prerequisite: the equivalent of one year of college algebra. M W F 9:05. Warren 201. Discussion section to be arranged. Mr. Searle.

Basic matrix algebra with applications in biology, business, economics, and statistics. Arithmetic procedures and other matrix operations; determinants, rank and linear independence, latent roots and vectors, solving linear equations, generalized inverses, direct sums and products. Use of matrices in regression analysis and linear statistical models.

510 Statistical Methods I. Fall term. Credit four hours. Prerequisite: graduate status or permission of instructor. M W F 9:05. Stocking 204. Laboratory to be arranged. Examinations will be held at 7:30 p.m. on Wednesday evenings. Mr. Davidson.
The use of probability models to portray the variations of observations arising through experimentation in biology and other fields is considered. Particular attention is given to the binomial, the Poisson, and the normal probability models. Techniques are developed for utilizing the information contained in observations arising from a specific population to make inferences about characteristics of the population. Topics include point and interval estimation, tests of hypotheses, inference for a single population, comparisons between two populations, regression and correlation analysis, and the one-way analysis of variance. Both parametric and nonparametric procedures are discussed. Emphasis is placed on basic statistical principles, criteria for selection of statistical techniques and the application of these techniques to a wide variety of biological situations.

511 Statistical Methods II. Spring term. Credit four hours. Prerequisite: 510 or the equivalent. M W F 9:05. Plant Science 233. Laboratory to be arranged. Examinations will be held at 7:30 p.m. on Wednesday evenings. Mr. Davidson.
The work of 510 is continued. Topics include multiple and curvilinear regression, complex analysis of variance and covariance. The analysis of variance discussion considers treatment designs, single degree of freedom contrasts, the simpler experimental designs, sampling errors, fixed, mixed and random models, and the effect of disproportionate numbers.

513 Design of Experiments I. Fall term. Credit four hours. Prerequisites: 417 and 511, or the equivalent. M W F 8. Warren 232. Discussion period to be arranged. Mr. Federer. Given in alternate years. Not given in 1973–74.
Principles and techniques of experimentation, theoretical concepts, extensions and variations of the completely randomized, randomized complete block, and latin square designs, the factorial experiment and confounding, fractional replication including response surface designs, lattice designs, crossover designs, augmented and other designs, covariance analyses, error rates, tests and interval estimation for ranked means, sample size, variance component analyses, unequal number analyses, the place of orthogonality in design, and advanced statistical methodology under various fixed, mixed, and random models.

514 Design of Experiments II. Spring term. Credit four hours. Prerequisite: 513. M W F 8. Warren 232. Discussion period to be arranged. Mr. Federer. Not given in 1973–74. A continuation of the work in 513 with emphasis on the role of confounding in experimental and treatment designs. Generalized forms of analyses and construction are presented followed by a discussion from selected topics, on long-term experiments, combination of results from several experiments, sequential experimentation, variance component analyses, estimation procedures, linear hypotheses, heritability studies, multivariate analyses, unequal numbers analyses, and related topics.

[517 Linear Models. Spring term. Credit three hours. S-U grades only. Prerequisite: 417, 511, and Mathematics 370 or 371. T Th 12:20. Warren 160. Mr. Searle. Given in alternate years. Not given in 1972–73.
Introduction to multinormal variables and distribution of quadratic forms; linear statistical models, estimable functions, and testable hypotheses; regression models, experimental design models, variance components models, and combinations thereof.]

518 Selected Topics in Biometry. Spring term. Credit three hours. Prerequisite: 511 or the equivalent. Time and place to be arranged. Mr. Robson.
Topics will be selected from a list including the principles and methodology of bioassay, discriminant functions, sequential analysis, nonparametric methods, mark-recapture methods, and statistical genetics.

[520 Design of Experiment III. Fall term. Credit three hours. Prerequisite: 417 and Mathematics 431–432 or the equivalent and consent of instructor. M W F 8. Warren 245. Mr. Federer. Not given in Fall 1972.
A mathematical development of the properties, construction, and analysis of experiment and treatment designs. Proofs to be given for known results and problems to be formulated in mathematical terms.]

499 Special Problems in Statistics and Biometry. Fall, spring, or summer. Credit one or more hours by arrangement wtih instructor. Prerequisite: permission to register. Biometrics Unit staff.

Vegetable Crops

Students planning to specialize to a greater or lesser extent in vegetable crops should consult the department regarding choice and sequence of courses. An outline of suggestions is available.

103 General Horticulture. Spring term. Credit four hours. Lectures, M W F 8. Caldwell 100. Laboratory, M W or Th 2–4:25. Guterman 110. Mr. Sheldrake.
An introductory course in general horticulture, including flower, fruit, and vegetable growing. Intended primarily for students who want a general knowledge of the subject, and for those who wish to specialize in some field of horticulture but have limited background either in practical experience or in training in botany and agronomy.

210 Vegetable Types and Identification. Fall term. Credit two hours. T 2–4:25. Guterman 110. Mr. Topoleski.
Designed to acquaint the student with the vegetable species grown in the Northeast and the pests and disorders encountered in their production. Subjects covered include identification of economically destructive weeds, diseases and insects of vegetables; identification of vegetable and weed seeds, seedlings, nutrient deficiencies and vegetable judging, grading and grade defects.

211 Commercial Vegetable Crops. Fall term. Credit four hours. Should be preceded by elementary courses in agronomy, botany, and chemistry. Prerequisite: 103 or its equivalent. Lectures, M W F 11:15. E. Roberts 222. Laboratory, W 2–4:25. Guterman 110. Mr. Ewing.
Intended for those interested in the commercial vegetable industry from the viewpoint of production, processing, marketing, or the related service industries. Topics included are techniques, problems and trends in the culture, harvesting, storage, and marketing of the major vegetable crops including potatoes. Several field trips are taken during the laboratory period and one or two week-end field trips are taken early in the fall.

312 Post Harvest Handling, and Marketing Vegetables. Fall term. Credit three hours. Lectures, T Th 9:05. Plant Science 141. Laboratory, Th 2–4:25. Guterman 110. Mr. Isenberg.
Practices and procedures used in marketing and shipping vegetables. Topics covered include legal structure of the market system, grade standards and methods of grading, the physical and legal aspects of packages, harvesting methods, hydrocooling, vacuum cooling and refrigeration principals, storage techniques and market preparation, use of sprout inhibitors and other chemicals, and objective methods used in quality control. Several field trips will be taken in early fall.

331 Undergraduate Research. Fall and spring terms. Credit one or more hours a term, by arrangement. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Any member of the staff.
Special problems may be elected in any line of vegetable work.

401 Vegetable Crop Physiology. Fall term. Credit five hours. Prerequisite: 211 and Biological Sciences 240 or their equivalent. Lecture, M W F 11:15. Plant Science 143. Laboratory, M 2–4:25. Discussion period to be arranged. Th and F afternoons. Mr. Kelly.
The physiological bases of cultural practice and the application of these principles to problems in vegetable production. Original literature is used to illustrate the principles involved. Experimental material is studied in the laboratory to amplify lecture topics. Subjects discussed include mineral nutrition as influenced by fertilization programs and crop sequence; nutrient interactions and induced deficiencies; growth and development; flowering; fruit setting; growth correlation; senescence; sex expression; photoperiodism; vernalization; and environmental factors affecting growth.

413 Kinds and Varieties of Vegetables. Fall term. Credit three hours. Given in alternate years. Prerequisite: 103 and 211 or permission to register. Laboratories, Th F 2–4:25. East Ithaca Fieldhouse. Mr. Minges and staff.
Designed to help students achieve proficiency in the evaluation of vegetable varieties through study of their origin, characteristics, adaptation, and usage. An important part of the course is the study of crops in the field. The vegetable seed industry is also discussed.

[429 Special Topics in Plant Science Extension. Spring term. Credit one hour. (Additional credit by special arrangement.) Given in alternate years. Lecture, F 8. Plant Science 141. Discussion period, F 2–4. Plant Science 37. Mr. Minges. Not given in 1972–73.
Designed for graduate students and advanced undergraduates in the several plant science fields who wish to acquire a knowledge of extension activities in preparation for careers in extension and associated work, such as research and technical work in both public and commercial organizations. Topics are related to extension in other countries as well as in the United States. Staff members from other plant science departments collaborate in teaching the course.]

501 Research Methods in Applied Plant Science. Spring term. Credit three hours. Given in alternate years. Prerequisite: permission of the instructor. Combined lectures and discussions, T Th 9:05. Plant Science 404. Mr. Kelly.
The planning of research programs as influ-

enced by various economic, administrative, political, and geographic environments. The advantages and limitations of conventional experimental designs as they apply to specific research problems. Discussions include a critical interpretation of experimental results from the literature. Many topics are directly applicable to the student's thesis research program.

601 Seminar. Fall and spring terms. Required of graduate students taking either a major or minor in this department. Undergraduates are welcome. Th 4:30. Plant Science 404. Members of Department staff.

610 Special Topics in Vegetable Crops. Fall and spring terms. Credit to be arranged. Prerequisite: permission to register. Time to be arranged. East Roberts 222. Mr. Ozbun.

512 Principles of Grade and Quality Estimation and Measurement. Fall term. Credit one hour. Lecture and demonstrations. Time and place to be arranged. Professor Hartman.
Study of grade and quality estimation and measurement of vegetables and vegetable products from the standpoint of the reactions of everyone involved in the handling and marketing channels and in consumption. For graduate students, especially in horticulture and food science. Studies of the data on the reactions of dealers, regulatory officials, and consumers to vegetables and vegetable products and the correlation of such data with the results of instrumental methods of measuring quality.

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